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G. E. BODKIN B.A. Dip. Agric. (Cantab), F.Z.S, F.E.S.

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// JOURNAL
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VOL. XI. JANUARY, 1918. No. 1.

The Editorship of The Board of Agriculture Journal.

MR. A. LEECHMAN, M.A., F.L.S., of Queen's College but formerly of this Department, who was Editor of this Journal during the long period 1909-1917 found himself unable to prepare prior to December 31st, 1917, the October, 1917, issue of this Journal, and early in January, 1918, expressed his desire of being relieved of its Editorship. This has been acceded to.

It is proposed that in future the Editorship of this Journal shall be confined to Officers of the Department of Science and Agriculture who are in close touch with practical agricultural questions. During recent years there has been a tendency for the Journal to drift from these in the direction of questions of scientific education and of general Science. This will be guarded against in future. Scientific matters closely connected with the forestral and mineral industries of the Colony will not be excluded.

Signed contributions from practical Agriculturists are invited and will be most welcome. Practical Agriculturists and Stock Farmers form an exceptionally modest race of men in British Guiana and *owing to this persist in* withholding their knowledge from others. It is to be hoped that in connection with this Journal their modesty will disappear and its issue become replete with practical advice and details of experience.

It is not possible to issue the number of the Journal which was due in October, 1917. His Excellency the Governor as President of the Board of Agriculture has requested Mr. C. K. Bancroft, Assistant Director of the Department of Science and Agriculture and Government Botanist, to act as Editor of the Journal until the Board of Agriculture has an opportunity of appointing a *permanent Editor. He made* an effort to prepare the number of the Journal which should have appeared in January, 1918, but owing to the extreme paucity of matter the late Editor had got together for the October and the January numbers it proved not possible to issue the number on the proper date.

It is to be hoped that the Board of Agriculture will select and induce Mr. Bancroft to be the *future* Editor of its Journal *and that* Mr. G. E. Bodkin, Economic Biologist, will assist in the work of preparing the Journal. Should this take place the subscribers to the Journal both local and foreign may rest assured that every effort will be made to *maintain in its issue a high standard of agricultural and* literary efficiency.

J. B. HARRISON.

February 5th, 1918.

The Destructive South American Locust in British Guiana.

AN ACCOUNT OF THE RECENT LOCUST INFESTATION.

By G. E. Bodkin, B.A., Dip. Agric. (Cantab), F.Z.S., F.E.S.,
Government Economic Biologist.

Only a few people witnessed the arrival of the vast swarm of locusts which invaded British Guiana from Venezuela via Yarakita in the North West District late in June 1917. Indeed it must have been a most remarkable spectacle. It has been described by eye-witnesses in various ways ; some likened it to a cloud in the sky which temporarily obliterated the light of the sun, while the sound of their flight is well represented by the wind-stirred rustlings of a multitude of dead and dry leaves evenly sustained and heard from afar. The passing of the swarm is supposed to have lasted from 7 a.m. to 3 p.m.

Each piece of cleared and cultivated land in the forest received its quota of winged locusts as the swarm passed over; more especially those areas situated on the higher lands. This distribution was most regular. Only a very few grants escaped. Roughly, the course taken by the swarm was over Yarakita (and here a number descended) and from thence all grants on the Aruau, Aruka, Barima and Waini Rivers were infested. They penetrated even to Arakaka and settled on cultivations in that neighbourhood.

Their course from the North West to the Pomeroon is uncertain. I have heard rumours of a large swarm being seen well out to sea but it seems more probable that they flew from point to point overland. Thus cultivations in the neighbourhood of Santa Rosa on the Moruca were attacked by the locusts as well as many Indian fields near Acquero and Waramuri on the same river.

The Pomeroon River appears to have been a particular

objective of theirs as almost every grant—and there are many—from the mouth of the river up to several miles beyond Charity soon swarmed with winged locusts.

Their energies however did not cease in the Pomeroon. From Hampton Court on the Essequibo Coast to Good Hope on the Supenaam Creek a large number of scattered areas suffered from locust attack. They penetrated some miles inland and attacked the fields of Arawak Indians residing on the large fresh water lakes in this neighbourhood. Still further progress was made and at several places on the left bank of the Essequebo River they made their appearance, including the Penal Settlement. The well known Hills Estate opposite the Penal Settlement on the same river was also infested.

This, as far as we know, was the limit of their flight. I have it on good authority that this immense swarm originated on some of the large islands at the mouth of the Orinoco. Thus the insects that reached the Penal Settlement must have covered some 200 miles and that largely against the wind; truly a most remarkable performance.

According to the established custom of migratory locusts, as soon as an offshoot from the main swarm settled on any cultivation the insects at once commenced to feed voraciously. In almost every instance Indian corn and sweet cassava were singled out and speedily defoliated. In one instance a portion of a crop estimated at 100 barrels was thus destroyed.

At this particular stage I had the opportunity of observing them in all the various localities with the exception of those areas on the upper Essequibo River. Their flight, on being disturbed, was strong and rendered capture difficult in the extreme, more especially as they invariably made off down wind. Feeding was done largely at night. Very few attempts were made to destroy them at this juncture and rightly so for the cost of labour thus expended would be far in excess of the value of the locusts destroyed. For instance a man might be occupied the whole day in chasing these insects and in the end would have hardly a hundred dead ones to show.

Within a fortnight of their arrival coupling of the sexes was observed and oviposition began. On the pegass soils of the North West District egg-laying took place on the drier and more rigid patches. A favourite localty seemed to be where a palm had orignally stood and the network of decaying roots mixed with soil was almost unversally selected. The somewhat higher ground on the edge of the draining trenches and on the dams themselves was also utilized. On the sandy soils which prevail in certain districts the eggs were deposited in any open space. During the early evening hours from about 3.30 to 5.30 this operation took place. An open piece of sandy soil with several hundreds of locusts all busy ovipositing presented a most peculiar spectacle. So engrossed were the locusts in their occupation that it was an easy matter to seize them between the finger and thumb and forcibly remove them.

During oviposition the male is invariably in attendance perched on the back of the female with a most tenacious hold. What active part he plays in the performance it is hard to say ; possibly as soon as the mass of eggs has been deposited by the female he is in a position to at once fertilize the embryos of another batch which will, in their turn, be deposited later on when mature.

In order to deposit the eggs beneath the surface of the soil it is necessary for the female to bore a hole. This is achieved by means of the hardened processes with which the anal end of the abdomen is provided. By opening and shutting these valves and at the same time gradually working her tail down into the soil a hole of the required depth is produced. A depth of about 1½-1¾ inches and in some cases 2 inches is reached. The deposition of the eggs is now commenced. First a small quantity of froth is exuded and the eggs follow in rapid succession and mixed with more froth. Finally a large quantity of froth is exuded and the female withdraws her tail and departs.

But little trace is left of her operations. In a few hours the mass of eggs becomes hardened and adheres firmly together in the bundle which appears as a roughly formed

cylinder conforming to the shape of the hole in which they were placed. The eggs in the mass all point upwards at right angles to the surface of the ground. The froth at the top and bottom of the mass soon hardens and forms a kind of protective wad for the eggs. Despite these precautions however an egg parasite has been bred out from a bundle of eggs dug up in a field in the North West District.

In size these eggs are equivalent to a well matured grain of rice and a dull yellowish brown in colour; a greenish tint is apparent at a later period of development. They also increase slightly in size and become softer. Finally the eyes of the contained embryonic locust are visible. The young locust ruptures the shell longitudinally when it emerges.

No farmers that I encountered on the preliminary survey of the locust-invaded areas realized the true significance of this immense swarm. They understood the destructive possibilities of the present winged form but were sceptical as to their powers of increasing a thousandfold. A disillusionment took place when the egg-laying process was shown and again on the appearance of the hoppers.

The first eggs to hatch were in the North West District. A period of about 3-4 weeks constitutes the incubation period. Gradually all over the district, followed by the other later infested areas, the hoppers started to emerge greatly to the consternation of everyone, and the question at once became urgent as to the most rapid and effective methods of eliminating such devastating hordes of insects.

In a country where peculiar phenomena of insect life are almost everyday incidents the emergence of this colossal swarm of young hoppers created a spectacle calculated to arouse the liveliest attention in the most blasé individual. In Georgetown, on the East and West Coasts of Demerara, and in far Berbice people vaguely wondered whether these accounts of locusts in the other parts of the colony were exaggerations or totally untrue. The majority did not know what a locust was. Only the agriculturists in the locust invaded areas and others who saw the swarm of adult insects and hoppers can testify as to the alarming spectacle which they presented.

Shortly after oviposition began a large number of eggs were brought to the Biological Laboratory and a complete life history has been worked out by Mr. L. D. Cleare, Jnr. A short description of the various stages may be given here. Locusts, in common with all other insects belonging to the great Natural Order Orthoptera which includes grasshoppers, roaches, stick insects, mantids and crickets have no worm stage as do the butterflies, beetles, and bees. They attain maturity by first issuing from an egg and then through successive stages all of which are imperfect forms of the adult insect. Wings are only evident in the complete stage.

Stage 1. Length, slightly over ¼ inch. Light pea-green in colour with dull black markings and spots. Body covered with fine hairs. Horns (antennae) black. A black line along the back. Duration of this stage 8 days.

Stage 2. Length not quite ½ inch. Body black with light markings. The black line along the back broadened considedrably. Two broad black bands along each side. Head mostly black. Legs largely black. Surface beneath body yellow-brown with black spots. Duration of this stage 7-8 days.

Stage 3. Length slightly over ½ inch. Markings etc., closely resemble previous stage. Front of head a brownish colour. Legs slightly lighter in colour. Ventral surface shows a medium white stripe. General colour lighter than preceding stage. Duration of this stage 10-13 days.

Stage 4. Length ¾ inch. Very like last stage in appearance. Wing pads now conspicuous. Antennae somewhat longer. Duration of this stage 10-13 days.

Stage 5. Length 1½ inches. Wing pads well developed and black colour. White stripe on thorax broad. Otherwise resembling previous stage. Duration of this stage 9-11 days.

Stage 6. Length almost 1¼ inches. Light areas pinkish brown in colour. Otherwise much like last stage. Duration of this stage 14-16 days.

The Adult. Length 2 inches; wing expanse 4½ inches. The general colour is dull rusty yellow with darker markings on the wings. The ventral surface is yellowish and the male is decidedly smaller than the female. The adult insects bred in British Guiana are more of a greenish yellow than the previous generation which came from Venezuela.

A number of control methods were devised according to local conditions, all of which proved efficacious.

During dry weather burning proved an excellent means of destroying the hoppers. The usual practice was to locate a large swarm, surround them with a generous supply of dry and quick burning bush and then set fire. In the earlier stages—(up to about the third stage)—this worked excellently. Later on the increased powers of locomotion of the hoppers enabled many to jump through the fire and escape. Burning a swarm situated in high grass was useless as the majority descended to the damp tangled growth at the roots; there the fire passed harmlessly over them.

In the earlier stages of the hoppers, small canvas sheets, banana leaves or young troolie leaves, well smeared with tar, proved an excellent trap. Wherever a number of young hoppers were observed to be clustered together they were brushed off on to these tarred surfaces and adhering thereto were rapidly killed. The most viscous quality of American tar was utilized. This method was largely used in the North West District both on a large and small scale and proved highly efficacious.

Driving into draining trenches where the surface of the water had previously been coated with a film of kerosene oil yielded beneficial results. This in conjunction with the burning method was widely practised in the Pomeroon.

A further ingenious method was introduced by Mr. E. S. Nicholson of Anna Regina. Tarpaulins about 12 feet square

were smeared with the thickest molasses. A large swarm of hoppers having been located this sheet was laid out on the ground in the proposed direction of the drive. The swarm was then surrounded by a number of individuals and gently yet firmly urged towards the tarpaulin. Obviously this method can only be exercised where the *terrain* is only slightly encumbered by vegetation. It would be quite impossible, for instance, to utilize such a means in high grass.

For wholesale destruction of well matured hoppers in large swarms this method cannot be approached. At Good Hope on the Essequibo Coast in the provision farms of the villagers the molasses method accounted for many thousands of hoppers daily. The ground here was peculiarly suited to this particular manoeuvre.

Although large supplies of poisons were secured by the Government early in the campaign and offered for sale at half the original cost price only very few people availed themselves of such an opportunity.

This may be accounted for by the fact that the average small agrculturist of the Colony is not an individual blest with a large share of this world's riches; indeed the majority of them have to work hard to secure the absolute necessities of life. It is also likely that the handling of such poisons is a matter of uncertainty among such people.

So much then for the suggested control measures; another, and not quite so pleasant a phase of control must now be described.

In 1914 an Ordinance entitled the Insect Pests and Plant Diseases (Prevention) Ordinance became a law of British Guiana. By its instrumentality any person who failed to carry out instructions issued by the Board of Agriculture as to the destruction of any pest, on summary conviction, became liable to a fine not exceeding one hundred dollars.

In the present case this Ordinance was manipulated early in the campaign with most beneficial results. In every agricultural community there exist idle individuals who are

fond of concealing such characteristics beneath a cloak of religion or other suitable screen. There are others again who are so lazy that they have not even sufficient energy to attempt to conceal the fact. Supineness is their daily practice. It was against such persons that this Ordinance was brought to bear. No honest hardworking man suffered thereby; many recalcitrants were brought to book and not a few of them were severely fined.

On the whole however the small farmers and grantholders within the infested areas worked splendidly and their fellow-agriculturists in other parts of the colony owe them a debt of gratitude for having destroyed a very real menace to all cultivations throughout British Guiana. The position to-day can be *termed satisfactory.* On the Pomeroon River and at Good Hope on the Essequibo Coast a number of the hoppers have attained maturity and consequently powers of flight. Elsewhere the "locust pest" has been eliminated.

Food in War Time. †

Under the above heading the following highly interesting and practical article by Professor Graham Lusk of Cornell University Medical College which deals with a subject at present foremost in our thoughts is here reproduced from the "Scientific Monthly" Vol. 5, Nov. 4, 1917:—

There is no doubt that under the conditions existing before the war the American people lived in a higher degree of comfort than that enjoyed in Europe. Hard times in America have always been better times than the best times in Europe. As a student in Munich in 1890 I remember paying three dollars a month for my room, five cents daily for my breakfast consisting of coffee and a roll without butter and thirty-five cents for a four course dinner at a fashionable restaurant.

† An Address prepared at the request of the U.S. Food Administration

This does not sound extravagant, but it represents luxury when compared with the diet of the poorest Italian peasants of southern Italy. Two Italian scientists described how this class of people live mainly on cornmeal, olive oil and green stuffs and have done so for generations. There is no milk, cheese or eggs in the dietary. Meat in the form of fat pork is taken three or four times a year. Cornmeal is taken as "polenta," or is mixed with beans and oil, or is made into corn bread. Cabbage or the leaves of beets are boiled in water and then eaten with oil flavoured with garlic or Spanish pepper. One of the families investigated consisted of eight individuals, of whom two were children. The annual income was 424 francs or $84. Of this three cents per day per adult was spent for food and the remaining three-fifths of a cent was spent for other purposes. Little wonder that such people have migrated to America, but it may strike some as astonishing that a race so nourished should have become the man power in the construction of our railways, our subways and our great buildings.

Dr. McCollum will tell you that the secret of it all lies in the green leaves. The quality of the protein in corn is poor but the protein in the leaves supplements that of corn so that a good result is obtained. Olive oil when taken alone is a poor fat in a nutritive sense, but when taken with green leaves these furnish that one of the peculiar accessory substances, commonly known as vitamines, which is present most abundantly in butter fat, and gives to butter fat and to the fat in whole milk its dominant nutritive value. The green leaves also furnish another accessory substance which is soluble in water and which is necessary for normal life. Furthermore the green leaves contain mineral matter in considerable quantity and in about the same proportions as they exist in milk.

Here then is the message of economy in diet, corn the cheapest of all the cereals, a vegetable oil cheaper by far than animal fat, which two materials taken together would bring disaster upon the human race, but if taken with the addition of cabbage or beet tops they become capable of maintaining mankind from generation to generation. One can safely refer to such a diet as a balanced diet.

This preliminary sketch shows several important fundamentals of food and nutrition. If one gives an animal a mixture of purified foodstuffs, pure protein, pure starch, purified fat, and a mixture of salts like the salts of milk, the animal will surely die. But if one substitutes butter fat for purified fat and adds a water solution of the natural salts of milk, the animal lives and thrives.

Again the illustration shows how corn may be so supplemented with other foodstuffs as to become extremely valuable in nutrition. It is especially valuable at the present time because corn is comparatively cheap and plentiful. But one asks how about pellagra? It must be here definitely stated that the use of corn meal is not the cause of pellagra provided the right kind of other foods be taken with it. Pellagra occurs in the "corn belt" of the United States, and especially among the poorer classes in the south. The disease has developed since the introduction in 1880 of highly perfected milling machinery which furnishes corn and wheat completely freed from their outer coverings.

In Italy, where the milling of corn is still primitive, pellagra is not as severe as with us, because the corn offal is not completely removed and this contains the accessory food substances or vitamines which are essential to life. Pellagra is generally believed to be produced by a too exclusive use of highly milled corn and wheat flour in association with salt meats and canned goods, all of which are deficient in vitamines. The administration of fresh milk is naturally indicated. Goldberger states that after the addition of milk to the diet of a pellagrin the typical clinical picture of pellagra no longer persists. The poor in the mill towns of the south lived too exclusively on a corn diet without admixture of milk or fresh animal food or even of cabbage, and pellagra has been the consequence.

The Food Administrator asks us to eat corn bread and save the wheat for export. It is a very small sacrifice to eat corn bread at one meal or more a day. Indian corn saved our New England ancestors from starvation, and we can in part substitute it for our wheat and send the latter abroad

to spare others from starvation. The simplest elements of patriotism demand that we do this. Therefore let us cry "Eat corn bread and save the wheat for France, the home of Lafayette!"

Another point in war economy is the use of whole milk in greater quantity, and the diminution of the use of butter and cream. Cream is bought only by the wealthy, but in sufficient volume to largely reduce the amount of whole milk available. In Germany before the war 15 per cent. of the milk supply of that country was used for the production of cream Regarding the use of butter a Swiss Professor, himself an expert in nutrition, complains that whereas in his youth children were never given butter on their bread for breakfast, not even when there was no jam in the house, yet to-day absence of butter from the table is held to be indicative of direst poverty.

If one takes a pint of whole milk daily, or even, as we have seen, cabbage or beet tops in its stead, one may take fat in the forms of oleomargarine, olive oil or cotton-seed oil without possible prejudice to health. The legal restrictions placed upon the sale of oleomargarine and the taxes enhancing its cost, now in operation in many of our States, are without warrant in morals or commonsense and should be entirely abolished in times like these. A well-made brand of oleomargarine is much more palatable than butter of the second grade, and certainly for cooking purposes is just as valuable.

Whole milk contains everything necessary for growth and maintenance, protein, fat, milk-sugar, salts, water and the unknown but invaluable accessory substances. It is of such prime importance that each family should have this admirable food, that I have suggested that no family of five should ever buy meat until they have bought three quarts of milk. The insistence by scientific men upon the prime importance of milk has probably had something to do with its rapid enhancement in price. This latter factor is greatly to be regretted. I have often wondered why it was that a quart bottle of a fancy brand of milk in New York should cost about as much as a quart of *vin ordinaire* on the streets of Paris,

and a quart bottle of cream as much as a quart of good champagne in Paris. Despite much denial it appears to me that milk is not sold as cheaply as it ought to be. Everything should be done to conserve our herds of cows for the increased supply of whole milk and incidentally for the manufacture of cheese and of milk powder or of condensed milk.

If one takes milk with other foods meat may be dispensed with. Thus Hindhede advocates as ideal a diet consisting of bread, potatoes, fruit and a pint of milk. Splendid health, both of body and mind, the peasants' comparative immunity to indigestion, kidney and liver disease, as well as an absolute immunity to gout, is the alluring prospect held out by the following dietary:—

Graham bread	1 lb.
Potatoes	2 lbs.
Vegetable fat	$1\frac{1}{3}$ lb.
Apples	$1\frac{1}{2}$ lbs.
Milk	1 pt.

This bread-potato-fruit diet gives a very excellent basis of wholesome nutrition. The potatoes yield an alkaline ash which has a highly solvent power over uric acid, and therefore a good supply of these valuable tubers is needed by the nation.

To most Americans the dietary factors here described will appear to be merely attentuated hypotheses, fit only for philosophic contemplation. For, in real life it is the roast beef of Old England, or some other famed equivalent, that makes its appeal. For be it from me to disparage the feast following a hunt of the wild boar or other feasts famed in song and story, but that is not the question. The question is, is meat necessary ? The description of the Italian dietary answers this in the negative.

But is meat desirable ? The Italian experimenters believed that the addition of 4 or 8 ounces of meat to the dietaries of some of their subjects increased their physical and also their mental powers. The increase in mental power due to change in diet has always seemed to me to be a figment of

the imagination and not susceptible of demonstration. Thomas lived for 24 days on a diet of starch and cream, during 4 days of which time the very small quantity of 3 ounces of meat was taken daily, and he found his mental and muscular power unchanged.

A remarkable experiment on the effect of a potato diet has been reported by Hindhede. An individual partook of a diet of between 4½ and 9lbs. of potatoes daily with some vegetable margarine during a period of nearly three hundred days. The rule was to eat only when hungry, and then the potatoes could be taken at the rate of an ounce a minute. During the last three months (95 days) of the experiment severe mechanical work was performed and the total food intake for the latter period amounted to 770 lbs. of potatoes and 48lbs. of margarine. What could be more simple than stocking the cellar with coal, potatoes and a tub of margarine! Who then would worry about the complexities of modern life?

Of course vegetarianism is no new thing. Its principal exponent was Sylvester Graham. It so happens that he was the brother of my great grandmother, and of him my father wrote in 1861 "long lanky Sylvester Vegetable Graham, leanest of men." Graham in 1829 began the advocacy of moderation in the use of a diet consisting of vegetables, Graham bread fruits, nuts, salt, and pure water, and excluding meat, sauces, salads, tea, coffee, alcohol, pepper and mustard. The first effect of this diet, which largely eliminated the flavours, was to reduce the weight through lowering the intake of food, but the health of many followers of the diet appears to have been benefited. The "Graham" System of dieting suffered from withering criticism at the time. He published in 1837 a little book entitled: "Bread and Bread-Making," bearing on its cover the scriptural quotation "Bread Strengtheneth man's heart." He says in this volume :—

"But while the people of our country are entirely given up as they are at present, to gross and promiscuous feeding on the dead carcasses of animals and to the untiring pursuit of wealth, it is perhaps wholly vain for a single individual to raise his voice on a subject of this kind?"

The well-known work of Chittenden has shown that when the protein intake is reduced by one half or less of that which the average American appetite suggests, professional men, soldiers and athletes may be maintained in the best physical condition. One of Yale's champion intercollegiate athletes won all the events of the year in which he was entered while living on a reduced protein or Chittenden diet. Upon such a diet, or less than that, the people of Germany are now living to-day. The principle involves eating meat very sparingly, taking a half a piece where one would have formerly been taken, and using it only for its flavour. The wing of a chicken has little meat on it and yet if eaten together with vegetables it gives the meal a different quality than it would have had without it, and to this extent its use is warranted. The muscles are active when hard labour is done, but the muscles do not need meat for the performance of their work. A fasting man may have considerable power. The popular idea of the necessity of meat for a labouring man may be epitomized in the statement: a strong man can eat more meat than a weak one, hence meat makes a man strong. The proposition is evidently absurd.

Indulgence in meat is due to the desire for strong flavour. With the increased demand of wealth, the demand for meat grows. Its consumption by all classes had vastly incresed in all prosperous countries prior to the war. It is well, however, to remember that its use has been excessive and unnecessary, and its price can be cut by wholesale voluntary abstinence. The British people have suffered no hardship in the recent reduction of their meat ration.

A British Commission has reported to Parliament that it takes three times as much fodder to produce beef as it does to produce milk or pork of the same food value. Since cows eat chiefly hay and grass and pigs eat grain the cost of production of a unit value of milk is much less than the cost of the same value in the form of pork. It takes only fifty per cent. more fodder to produce veal than to produce pork. Milk, pork and veal have long been the established protein-containing foods of nations on the continent of Eu-

rope. According to these figures beef should cost in the market twice what veal costs, and yet the butcher charges nearly the same for the two. It would save food for milk production if steers were eaten as veal and not fed up into beef cattle. If all heifers were developed into milch cows and no cow capable of giving milk in quantity were slaughtered, the country would be placed on a much better basis than at present. It would make beef expensive, but there is every reason why it should be expensive. It would increase the dairy business, which is evidently a need of the times, something for the protection of the welfare of mankind. For it must be remembered that a well-nourished cow during a single year will give in the form of milk as much protein and two and a half times the number of calories as are contained in her own body.

This was written before the publication of the following words of Armsby, the foremost authority on animal nutrition:*

"Roast pig, to those who like it, is not only a delicacy but a valuable article of diet, but nevertheless it is possible to pay too high a price for it, and while a proposal to restrict rather than to promote meat production in the present crisis may appear both irrational and unpatriotic it may nevertheless be in the interest of true food economy.

It may be roughly estimated that about 24 per cent. of the energy of grain is recovered for human consumption in pork, about 18 per cent. in milk and only about 3·5 per cent. in beef and mutton. In other words, the farmer who feeds bread grains to his stock is burning up 75 to 97 per cent. of them in order to produce for us a small residue of roast pig, and so is diminishing the total stock of human food.

The task of the stock feeder must be to utilize through his skill and knowledge of the inedible products of the farm and factory such as hay, corn stalks, straw, bran, brewers' and distillers' grains, gluten feed, and the like, and to make at least a fraction of them available for man's use. In so doing

* "Roast Pig," SCIENCE, 1917, XLVI., 160.

he will be really adding to the food supply and will be rendering a great public servce. Rather than seek to stimulate live stock husbandry the ideal should be to adjust it to the limits set by the available supply of forage crops and by-product feeding stuffs while, on the other hand, utilizing these to the greatest practicable extent, because in this way we save some of what would otherwise be a total loss.

The hog is the great competitor of man for the higher grades of food and in swine husbandry as ordinarily conducted we are in danger of paying too much for our roast pig. Cattle and sheep, on the other hand, although less efficient as converters, can utilize products which man cannot use and save some money of their potential value as human food. From this point of view, as well as on account of the importance of milk to infants and invalids, the high economy of food production by the dairy cow deserves careful consideration, although of course the larger labour requirement is a counterbalancing factor.

At any rate, it is clear that at the present time enthusiastic but ill-considered " booming" of live stock production may do more harm than good. If it is desirable to restrict or prohibit the production of alcohol from grain or potatoes on the ground that it involves a waste of food value, the same reason calls for restriction of the burning-up of these materials to produce roast pig. This means, of course, a limited meat supply. To some of us this may seem a hardship. Meat, however, is by no means the essential that we have been wont to suppose and partial deprivation of it is not inconsistent with high bodily efficiency. Certainly no patriotic citizen would wish to insist on his customary allowance of roast pig at the cost of the food supply of his brothers in the trenches.

Heat from the sun enters into the composition of the food substances when they are being built up in the plants, and this energy, which is latent in the food, is set free in the animal body and is used as the source of power behind all the physical activities of the body. The energy can all be recovered as heat and measured in the form of calories. Ac-

cording to the principles of the law of the conservation of energy, heat is not destructible. The understanding of the value of a calorie is indispensable for the comprehension of nutrition. A calorie is the measure of a unit of heat, or the quantity of heat necessary to raise a liter of water from 0° to 1° centigrade. Apparatus has been invented for measuring the heat production of a man, an apparatus which is called a calorimeter or a measurer of calories. If one puts a man weighing say, 156 pounds in the box of such an apparatus, so that he lies comfortably on a bed in complete muscular relaxation, and before his breakfast, one finds that he produces 70 calories an hour. Only in certain types of disease is there any variation from this normal, though of course the weight of the man makes a difference in his requirement for energy. If, at the same time the subject is in the box, the quantity of oxygen which he absorbs is measured and if certain other chemical analyses be carried out, one can calculate the exact amounts of protein fat, and sugar which have been oxidized by this oxygen. Now if one calculates how much heat ought to have been set free from the oxidation of these quantities of protein fat and carbohydrate, it is discovered that the heat which ought to have been produced is exactly that quantity which was measured as having been produced by the man This measurement represent the *basal metabolism* of a man at complete rest, when his oxidative activities are at their lowest ebb.

The basal metabolism as measured by 70 calories per hour in the case of this individual represents the sum of the fuel needed (1) to maintain the beating of the heart, which every minute of a man's life moves the blood or one-twentieth part of the weight of the body in a circle through the blood vessels ; (2) to maintain the muscles of respiration that the blood may be purified in the lungs; (3) to maintain the body temperature at that constant level which is so characteristic that a slight variation signifies illness, and (4) to maintain in the living state the numerous tissues of the body. Any extraneous muscular movements are carried out in virtue of an increased oxidation of materials and the heat production rises above the level of the basal metabolism with increased muscular effort. For a long time the power

for the maintenance of the human machine can be furnished by its own body fat, as is seen in cases of prolonged fasting, but usually the power is derived instead from the food fuel which is taken. The great question in the world to-day is whether or not a sufficient quantity of food fuel is available to support the human family. The question of calories is not an academic one, but an intensely practical one.

The following values may be cited from the literature on the subject, as showing the daily requirements of energy for working people when the work day is of eight hours. A seamstresses sewing with a needle required 1,800 calories. Two semstresses using a sewing machine required 1,900 and 2,100 calories. Two women book-binders required 1,900 and 2,100 calories. Two household servants employed in such occupations as cleaning windows and floors, scouring knives, forks and spoons, scouring copper and iron pots required 2,300 to 2,900 calories. Two washerwomen, the same servants as last named, required 2,600 to 3,400 calories in fulfilment of their daily work.

Concerning the fuel requirement for the occupations of men : Two tailors required 2,400 and 2,500 calories. A book-binder required 2,700 and a shoemaker 2,800. Two metal workers filling and hammering metals required 3,100 and 3,200 calories. Two painters occupied in painting furniture required 3,200 and 3,300 calories and two carpenters engaged in making tables required the same amount of energy. Farmers of all nationalities—United States,, Mexico, Italy, Finland required 3.500. Two stonemasons chiseling a tombstone required 4,300 and 4,700. Two men sawing wood needed 5,000 and 5,400 calories.

Other studies upon the requirements of lumbermen engaged in chopping and yarding logs, bicycle riders in six-day bicycle races and men engaged in long mountaineering ascents show that the demand for food-fuel may reach 10,000 calories daily.

It is evident from this analysis that whenever there is physical labour to be accomplished the demand for food-fuel in-

creases. The present world food situation depends not only on a short wheat crop but also upon the fact of an increased demand for food-fuel on account of an increased speeding up of the human machines, which latter factor includes a largely increased amount of muscular work done by women.

A British Scientific Commission has reported to Parliament that if the workman be undernourished he may by grit and pluck continue his labour for a certain time, but in the end his work is sure to fail. It makes no difference what the nutritive condition of the person is, if a certain job involving muscular effort is to be done it always requires a definite amount of extra food-fuel to do it. Rubner, the greatest German authority on nutrition, excited grossly inappropriate hilarity in the comic press of his country, by showing that a poor woman who waited several hours in line in order to receive the dole of fat allowed her by the Government, actually consumed more of her own body fat in the effort of standing during those hours than she obtained in the fat given her when her turn to receve it came at last.

A method by which food-fuel can readily be saved with benefit to the nation and to the individual is for the over-fat to reduce their weight. This has been done with drastic severity in Germany. I have heard from unquestioned sources how a man who had weighed 240 pounds lost 90 pounds since the war began ; how a corpulent professor at Breslau lost greatly in weight, but during the second summer of the war regained his former corpulence during a sojourn in the Bavarian Tyrol, a joy not now tolerated; and how an American woman lost 40 pounds in weight last winter in Dresden. There is every reason why a man who is over-weight at the age of fifty should reduce his weight until he reaches the weight he was when he was thirty-five. According to Dr. Fiske he is a better insurance risk if after thirty-five he is under the weight which is the average for those of his years. Reduction in weight reduces the basal requirements for food and reduces the amount of fuel needed for moving the body in walking. The most extreme illustration of the effect of emaciation upon the food requirements is afforded by a woman who after losing nearly half of her body weight was

found to need only 40 per cent of the food-fuel formerly required. This represented a state not far from the border line of death from starvation, but it indicates how a community may long support itself on restricted rations. It must be strictly borne in mind, however, that if any external muscular work is to be accomplished it can only be effected at the expense of a given added quantity of food-fuel, whether the person be fat or thin.

It is not at all difficult to reduce the body weight. Suppose a clergyman or a physician requires 2,500 calories daily in the accomplishment of his work and takes 2,580 calories per day instead. The additional 80 calories is the equivalent of a butter ball weighing a third of an ounce, or an ounce of bread or half a glass of milk. It would seem to be the height of absurdity to object to such a trifle. But if this excess in food intake be continued for a year the person will gain nine pounds and at the end of ten years ninety pounds. Such a person would find that he required a constantly increasing amount of food in order to transport his constantly increasing weight. In instances of this sort a motto may be applied which I heard the last time I was in Washington: "Do not stuff your husband, husband your stuff.

Now it is evident that, if instead of taking more than the required amount of food a little less be taken than is needed the balance of food-fuel must be obtained from the reserves of the body's own supply of fat. By cutting down the quantity of fat taken, or by eliminating a glass of beer or a drink of whisky, and not compensating for the loss of these by adding other foodstuffs, the weight may be gradually reduced. The amusing little book entitled "Eat and Grow Thin," recommends a high protein and almost carbohydrate-free diet for the accomplishment of this purpose, but its advice has made so many of my friends so utterly miserable that I am sure that in the end it will counteract its own message.

The work of the world is accomplished in largest part by the oxidation of carbohydrates, that is to say of sugars and starches. Bread, corn, rice, macaroni, cane-sugar, these are *par excellence* the food-fuels of the human machine. They

are all convertible into glucose in the body, which glucose gives power to the human machine. Fat may be used for the same purpose, but unless carbohydrate is also present a person can not work up to his fullest capacity.

As all the world is seeking for food-fuel with which to do work, I want to place before you a plea that the public be informed as regards the energy value of its purchases. It is but repetition of an already published statement.*

A barrel of flour weighs 196 pounds. One pound of flour yelds 1,650 calories. Our barrel of flour, therefore, contains 1,650 times 196, or 323,400 calories. The farmer in 1916 received $1.50 a bushel for his wheat, which would make the barrel of flour cost about $7.50. In February, 1917, the cost was $9 a barrel, whereas in May of the same year it sold at retail at $17 and more a barrel and in August the price had fallen slightly. These costs may thus be reckoned:

	Price per barrel of 323,400 Calories.	Price per 1,000 Calories.
Flour, based on 1916 price of wheat paid to farmer....	$7.50	$ .023
Flour, February 1917	9.00	.028
Flour at retail in New York, May 22, 1917.................	17.12	.033
August 27, 1917.............	15.29	.048

Since one third of the food-fuel of America, England, and France is derived from flour, it is evident that the extortionate price exacted for bread, which has been called the staff of life, puts a severe load upon the human family and has placed under fire the modern machinery of food speculation which has made such prices possible. Passing now to a consideration of the foods sold in packages. I bought at a

* World's Work, August, 1917.

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department store on May 22 the following foods, at the following cost per thousand calories:

PRICE PER 1,000 CALORIES.

Cornmeal	$3\frac{2}{3}$	cents
Karo Corn Syrup	$5\frac{1}{2}$	„
Wheatena	8	„
Grape Nuts	$8\frac{1}{2}$	„
Sunshine Cheese Wafers	15	„
Quaker Oats	$4\frac{1}{3}$	„
Cream of Wheat	$5\frac{3}{4}$	„
Corn Flakes	$8\frac{1}{4}$	„
Animal Crackers	$11\frac{1}{2}$	„
Nabisco Wafers	32	„
Imperial Cheese	41	„

I firmly believe that a great advance would be scored if the value in calories were placed on every food package sold.

As to the use of alcoholic beverages the question resolves itself into several factors. Alcohol gives a sham sensation of added force and in reality decreases the ability to do work. Alcohol is the greatest cause of misery in the world and as Cushny has put it, if alcohol had been a new synthetic drug introduced from Germany, its importation would long since have been forbidden. On the other hand good beer makes poor food taste well. It also frequently leads to overeating. The cure for bad food is to have our daughters taught how to cook a decent meal. After that we can talk about prohibition.

The food situation is probably more serious than most of us realize. The country should be stirred to a keener sense of its responsibilities. In conclusion, let us agree if we can to the following propositions:

1. Eat corn bread and save the wheat for France, the home of Lafayette, and for our other allies.

2. Let no family (of five persons) buy meat until it has bought three quarts of milk.

3. Save the cream and butter and eat vegetable oils and oleomargarine.

4. Eat meat sparingly, rich and poor, labourer and indolent alike.

5. If fat, grown thin.

6. Be a prohibitionist for the period of the war (if you have enough resolution.)

7. Save everything that can be used for food, because food is precious.

8. Finally remember that all the world is seeking for food-fuel with which to do work and that though our wheat crop is short, still we are the nation most richly endowed with food fuel. It remains to be seen whether we have the intelligence to fitly utilize for the welfare of mankind the resources which God and nature have placed in our hands.

Sugar Cane at the Experimental Fields in 1916.

By Professor J. B. Harrison, C. K. Bancroft and R. Ward.

The crops on the Experimental Fields generally during the last few years have become very unsatisfactory and irregular. This has been due in the first place to the exceptionally heavy nature of the soil. Part of the land (the South Field) was under continuous cane cultivation from 1890 to 1913. It was rested from cane cutlivation during 1914 and 1915 and was replanted in May, 1916, a series of trials having been designed to test the use of rice-straw on it as a manure and especially as an ameliorant to the texture of the heavy clay soil. The North-East Field has been under continuous cane cultivation from 1900 to date. It no longer produces regular and satisfactory crops of cane although it is in better tilth than is the South Field. The North-West Field has the heaviest clay soil of any of the fields and its yielding powers showed signs of failing after eight crops. But the growth of the canes on it during 1916 indicated that even a short rest from cane cultivation has been beneficial to it. Unfortunately it is not possible to place the land at the Experimental Fields under water for a prolonged period, the only certain remedial treatment for such a soil

DISTRIBUTION OF SEEDLING CANES.

Two hundred and seventy-four thousand, two hundred and twenty cuttings of forty-four varieties of sugar cane were distributed to plantations in the colony. The varieties in greatest demand were:—

Varieties.	No. of cuttings distributed.
D 118	27,950
Green Transparent	26,010
D 625	19,990
Jamaica 73	15,720
D 721	15,650
D 167	13,860
B 6450	10,030
D 419	9,880

RAINFALL.

The rainfall at the Botanic Gardens from January 1st, to December 31st was 88.52 inches. In May, June, November and December the total precipitation exceeded ten inches in each month. In March, April, September and October the total precipitation amounted only to 2.96, 1.29, 2.76 and 2.84 inches respectively. In each of the other months it exceeded 5 inches. The distribution of the rainfall was fairly regular and favourable to the growth of sugar cane.

MANURIAL EXPERIMENTS.

(a) Trials with Sulphate of Ammonia and Nitrate of Soda.

The crops on the Experimental Fields were reaped in November and December 1916. In the following tables which show the results obtained with artificial manures "low nitrogen" implies 30 lbs. of nitrogen in sulphate of ammonia per acre, "medium nitrogen" 60 lbs. of nitrogen in sulphate of ammonia or in nitrate of soda as the case may be, whilst "high nitrogen" is equal to 90 lbs. of nitrogen in sulphate of ammonia. These rates are equal to 150, 300 and 450 lbs. of sulphate of ammonia per acre respectively. The varieties under manurial trials on the north-east field comprised:—D 419, Jamaica 73, D 167, D 721, Green Transparent (plants), Green Transparent (ratoons) D 118, D 625, D 32, D 367, D 59, D 570, D 47, D 71, D 493. They gave the following mean results:—

Tons of canes per acre.

No. Nitrogen.	Sulphate of Ammonia.			
	Low.	Medium.	Nitrate of Soda.	High.
16.8	20.5	24.9	22.8	28.3

Tons of Commercial Sugar per acre.

No. Nitrogen.	Sulphate of Ammonia.			
	Low.	Medium.	Nitrate of Soda.	High.
1.68	2.04	2.47	2.16	2.95

The comparisons of sulphate of ammonia with its equivalent in nitrogen-content of nitrate of soda, 60 lbs. nitrogen per acre, resulted as follows:—

	Tons canes per acre.	Tons saccharose in juice per acre.
Sulphate of Ammonia	25.8	2.49
Nitrate of Soda	22.8	2.16

These results with the nitrogenous manurings are in accordance with those of former years.

(b) *Trials with Superphosphate.*

The following results were obtained with dressings of superphosphate on duplicate plots in the above experiment.

Plots without nitrogenous manure—

	Tons of canes per acre.
Without Superphosphate	16.8
With Superphosphate	17.2

Plots with nitrogenous manure—

Without Superphosphate	25.4
With Superphosphate	24.9

The results are confirmatory of earlier trials.

Another series of trials resulted in the following mean results.

	Tons Canes per acre.	
	Without Nitrogen.	With Nitrogen.
Without Superphosphate ..	18.1	23.5
With Superphosphate (250 lbs.)	19.8	23.1
With Slag Phosphate (600 lbs.)	21.1	25.4

The statement is often made that the application of super-

phosphate of lime tends to increase the sugar content of the expressed juice of the canes. In this connexion the mean results of analyses of the expressed juice in the above experiments are of interest:—

	Specific gravity.	Expressed Juice lbs. per gallon. Saccharose.	Glucose.
Without Phosphate ..	1.0682	1.622	.1989
With Phosphate ..	1.0696	1.647	.1092

The above results give but little support to this statement.

The mean yields of different varieties included in the abovementioned trials were:—

Variety.	Tons of Canes per acre.	Tons saccharose in expressed juice.
D 419	32.6	3.33
Jamaica 73	33.4	3.33
D 167	32.0	3.16
D 721	32.5	3.07
Green Transparent (plants)	25.8	2.95
D 118	27.9	2.89
D 625	33.1	2.85
Green Transparent (ratoons)	23.4	2.49
D 32	17.7	1.85
D 367	16.9	1.63
D 59	14.9	1.57
D 570	14.7	1.42
D 47	14.8	1.34
D 71	11.9	1.16
D 493	12.6	1.13

(c) Comparative trials with sulphate of ammonia, etc. and animal-products manure.

The results of trials made with animal-products manures such as dried blood, dried fish manure, and raw guano during the eighties, on an extended scale were given to us by the courtesy of certain estate agents in Georgetown. These and our own trials during the nineties proved so conclusive

that up to the present we have not felt justified in repeating them. War conditions however having caused difficulty in obtaining supplies of sulphate of ammonia, sugar planters became interested in the possibility of using as a source of manurial nitrogen sugar cane manures prepared from waste animal-products *in lieu* of sulphate of ammonia.

A series of trials using sixteen varieties of sugar cane was arranged for the comparison of the effects of the nitrogen contained in sulphate of ammonia, nitrate of soda, nitrolim, and a manufactured sugar cane manure of recent origin prepared from waste animal-products.

The plots were divided into two groups. To one group the manures were applied in proportions containing the same quantites of nitrogen in each manure, and to the other in proportions representing the same monetary value of each of the manures.

The manures in the former were applied in such quantities as to each supply 60 lbs. of nitrogen per acre; whilst in the latter the animal-products manure was applied in quantity supplying 60 lbs. of nitrogen at a purchase cost of $18.30 per acre, the other manures, including the quantity of superphosphate of lime necessary to bring about an equality in phosphates with the animal-products manure being each applied in the quantity purchaseable locally for that amount.

(i) *Equal Nitrogen Value.* The varieties of canes employed in the former trials were:—D 625, Green Transparent, D 581, D 118, D 71, D 206, B 6450, D 61, D 98.

The mean yields per acre were:—

TONS OF CANES PER ACRE.

No. Manure.	Sulphate of Ammonia.	Nitrate of Soda.	Animal-Products Manure.
28.5	35.7	34.0	32.2

The mean proportions of saccharose in the expressed juices of the varieties were:—

Lb. saccharose per gallon of expressed juice.

No. Manure.	Sulphate of Ammonia	Nitrate of Soda.	Animal-Products Manure.
1.632	1.623	1.623	1.611

The means of the results show that the varying sources of nitrogen, ammoniacal, nitric and organic, in the manures had no influence on the sugar-content of the juices.

The mean increases of cane and of saccharose in the expressed juices due to the application of the various manures supplying equal amounts of nitrogen are shown in tons per acre in the following table:—

		Tons per acre.	
		Sugar cane.	Saccharose in juice.
Sulphate of Ammonia	..	7·2	.73
Nitrate of Soda ..	..	5.5	.53
Animal-products manure	..	3.7	.44

It may be objected that several of the varieties are not cultivated on the large scale here and hence that the above mean increases obtained with them may not have practical value. The mean results with three widely cultivated varieties—D 625, Green Transparent and D 118—are not open to this objection. They were:—

		Tons per acre.	
		Sugar cane.	Saccharose in juice.
Sulphate of Ammoia	..	9.9	.74
Nitrate of Soda ..	..	7.2	.77
Animal-products manure	..	4.1	.32

It is very evident from the above experiment that the application of the manure prepared from waste animal

products has not been attended with satisfactory results and that sulphate of ammonia is on the heavy clay soil of and under the climatic conditions prevalent at the Experimental Fields far superior to a manure prepared from waste animal products.

The results of this series are in accordance with earlier trials with organic nitrogenous manures made in British Guiana.

(ii) *Equal Money Value.* The varieties employed in the latter trials were:—D 118, D 625, D 141, D 12, D 460, D 189, D 108, D 210, D 37.

The mean yields per acre were:—

Tons of Canes per acre.

No. Manure.	Sulphate of Ammonia.	Nitrolim.	Animal-Products Manure.
29.9	41.8	42.2	33.2

The mean proportions of saccharose in the expressed juices of the varieties were:—

Lb. saccharose per gallon of expressed juice.

No Manure.	Sulphate of Ammonia.	Nitrolim.	Animal-Products Manure.
1.691	1.640	1.645	1.682

The mean increases of cane and of saccharose in the expressed juices of the different varieties were:—

	Tons per acre.	
	Sugar cane.	*Saccharose in juice.*
Sulphate of Ammonia ..	11.9	1.07
Nitrolim	12.3	1.13
Animal-products Manure ..	3.3	.42

The relatively high cost of the nitrogen of low manurial value contained in the waste animal products manure ($6.66 per unit of nitrogen per ton of 2,240 lbs.) when compared with that of nitrogen in sulphate of ammonia ($4.70 per unit) and in nitrolim. ($3.40 per unit) placed the former manure at a marked disadvantage in this series of trials. The nitrogen in a waste animal-products manure must be sold here at a much lower price per unit than is nitrogen in sulphate of ammonia to enable the organic manure to compete with the latter on anything like even terms.

Rice in Madras.*

Rice is easily the most important crop in the Madras Presidency and the determining factor in its cultivation is a cheap and assured supply of water. Where water is plentiful, two and occasionally three crops are taken off the same land within the year. Over 10½ million acres are under rice, and rice land forms the chief gilt-edged security for the investments of the moneyed classes. The normal yield of padi is 1,800 lbs. per acre per crop but in many of the best tracts it reaches well over 4,000 lbs. per acre. The total annual yield amounts to over 8 million tons, worth roughly 85 crores of rupees ($177,083,333). By far the largest proportion of this vast bulk is consumed within the Presidency. In 1914-15 only 285,000 tons were exported, Ceylon being the largest purchaser. The cereal is exported as rice, not as padi; and the usual reckoning is that padi yields 66 per cent. of rice.

The varieties of rice are legion. They vary in duration

*We are indebted to a pamphlet entitled "Madras Agriculture" for the material of this article., Ed, Journal B. of A.

of growth, in colour of grain—both husked and unhusked—in strength of straw, in size and shape of grain and in shades of flavour. Where all are experts, minute differences in flavour and taste are often the controlling factors in the public demand—thus while the Muhammadans have shown a marked preference for the somewhat highly-flavoured rice introduced by the Agricultural Department from the Central Provinces, the Hindus find it too strong for their taste and style of cooking. Hence one of the chief lines of improvement of the crop is to increase the yield. Fortunately the rice plant exhibits a remarkable adaptability. It can be cultivated with success on divers soils, from heavy clay rich in organic matter to very sandy, provided the organic matter is present. It is a semi-aquatic plant, yet it can do with only partial flooding; it can stand an amount of salinity which would be fatal to other cereals; and it enjoys a notable immunity from disease.

Although rice does not cross-fertilise easily, this does take place, and few fields in old-established rice areas carry absolutely pure strains. The disadvantage is obvious. Much loss is occasioned at harvest by irregular ripening. The remedy is careful seed selection. Seed true to type can be had at the agricultural stations and is in very great demand. Another point is the proportion of husk to grain; and the progeny from a single plant selection at Palur Agricultural Station has become very popular on this ground. Weakness of straw in heavy yielding varieties will, it is hoped, be corrected by breeding. By taking care over the seed-bed, too, and thereby producing stronger and healthier seedlings and hence economy in transplanting), a saving of three to five rupees (98 cents to $1.60) per acre can be obtained.

Rice fields tend to become more and more heavy in soil character owing to the continued application of the water used in cultivation. Many rice soils contain nearly 59 per cent. of pure clay, and 80 per cent. of the smaller soil particles may belong to the finest grades. Experience has shown repeatedly that the application of large quantities of organic matter is needed to improve the fertility of rice lands and especially to maintain the texture of the soil. The best

method is to grow leguminous crops in the off season and plough them in. To assist growers, the Agricultural Department stocks seeds of such plants as *Tephrosia purpurea, Sesbania aculeata and Crotalaria juncea* (the Sunnhemp), and in 1915-16, 170,515 lbs. of such seeds were sold, yielding a profit of 1,461 rupees ($467.20). Where phosphates are lacking in the soil, small quantities of quick-acting phosphatic manures in conjunction with green manures are recommended. As regards the introduction of labour-saving machinery, this does not appear to be feasible at present. The cutting up of the fields by small dams practically precludes the use of motor ploughs and reaping machines. The only labour-saving appliance asked for has been the winnower for separating chaff.

The rice industry in Madras recognises no really well defined grades of quality. Most of the rice is bought on sample, and the so-called grades differ widely., At Cocanada, the chief rice port, the usual grades are—

A. Mill Rice—purely white, with no red coating or yellow colour in the grain.

B. Mill Rice—a little inferior to A, with slight red coating.

C Polished, but with yellow seeds and red coating.

Chabyam—or "cargo rice"—unpolished, with red coating.

"Bazaar boiled rice"—prepared by hand-mills, and of very inferior quality.

In rainy weather the standards are somewhat lower, and generally it is not possible to get Standard A.

Best Ways to Cook Fresh Vegetables. *

Even in time of peace, people eat more meat than is good for them; with a world shortage of food already upon us in these times of war, it behoves us all to economise. That much more use might and should be made of fresh vegetables will be generally conceded. Vegetables are in fact more healthful than a heavy meat diet, and they are much cheaper: the only difficulty lies in the cooking. Few people in English-speaking countries know how to make the most of vegetables, and fewer still seem able to cook them in such a way as to make an appetising dish. The hints contained in this article may help to remedy this state of affairs.

Take Lima Beans for instance. In food value they may be made almost twice that of whole milk; but to ensure this they must be boiled in but a little water. It is best to buy the beans in the pods and shell them just before using. Rinse in cold water, and put in the saucepan, cover with boiling water, and boil till tender. Some take only 20 minutes, others 30 to 35 minutes—that depends on their age and the length of time they have been picked. When tender, there should be very little water left. Add a teaspoon of salt to each quart of beans, a pinch of pepper and 1 tablespoon of butter. Shake the saucepan (do not stir so that it breaks the beans) and pour into tureen. Watch the saucepan carefully, so that the beans do not scorch.

For "Creamed Lima Beans" a sauce may be made thus—

1 rouned or 2 level tablespoons butter.
1 rounded or 2 level tablespoons flour
½ tablespoon salt
a dash of white pepper.
1 teaspoon grated onion or ½ teaspoon grated nutmeg for extra flavouring.
1 cup cold milk.

Put the butter into a shallow saucepan over the fire; when

* We are indebted to a pamphlet entitled "Best Ways to Cook Fresh Vegetables" by Mrs. Anna B. Scott (published by W. Atlee Burpee & Co.) for the recipes in this article. Ed. Journal, B. of A.

melted remove from the fire, add flour and mix until smooth. Return to fire and add cold milk, slowly stirring all the time. Add salt, pepper and flavouring, and boil 3 minutes. There is no need to strain. This sauce is the best of its kind for carrots, cabbage, cauliflower, celery, onions, salsify, turnips and other vegetables besides the beans.

Now take—

1 qrt. shelled Lima beans	1 tablespoon finely cut chives, parsley or celery tops.
1 cup cream sauce	
1 tablespoon onion juice	

Wash the beans, put in saucepan, cover with boiling water, boil 25 minutes, drain and slip each bean out of its "hull" as you would slip an almond from its skin. Return to saucepan with just enough water to cover, and boil slowly 20 minutes, or until the water has almost boiled away. Then cover with the cream sauce, add the grated or scraped onion, bring to boil and sprinkle with the chives, parsley or celery tops. Very young or tender beans need not be skinned—large, old beans only are used for this recipe.

Three **important—all-important—points** in cooking vegetables are—

i. Avoid over-cooking (which makes them tasteless and tough.)

ii. Always use *uncovered* vessels.

iii. Always *start* with *boiling* water.

String Beans are tasty and about two-thirds as nutritious as whole milk. String 2 qrts. of beans, cut into half-inch pieces and set aside in cold water 30 minutes, drain and cover with boiling water. Add 1 tablespoon of cut onion for flavour, and boil 30 minutes or until tender. Drain and cover with this sauce—

†2 tablespoons bacon drippings	2 tablespoons scraped onion
2 tablespoons flour	2 teaspoons salt.
	A dash of white pepper.

† Unless otherwise stated, all spoon measurements are "rounded" and not "level" spoonfuls.

Put the bacon drppings into a small frying pan, add the onion and flour, and mix well, then add the cold milk slowly. Boil 3 minutes; then add the salt and pepper. If you have no bacon drippings, fry two or three thin slices of bacon and use the bacon to garnish the beans.

String Beans and Mutton.

¼ peck string beans
1½ lbs. neck of mutton or lean stewing mutton
½ cup cut onions.
1 tablespoon salt and a little pepper
2 tablespoons flour
1 tablespoon finely cut chives or parsley.

Have the meat cut, as for stewing, in about 8 small pieces, wash in cold water, being sure that all splinters of bone are removed. Put into saucepan or boiler, cover with 2 qrts. of boiling water; boil slowly one hour. String and cut the beans into 1 inch pieces, cover with cold water 30 mins., then drain and add to the meat with the onion. Cover and boil 45 minutes; add salt, pepper, and the flour, which has been mixed with a little cold water. Boil 5 minutes, remove the meat to the centre of the platter, and arrange the beans with the sauce around it. Sprinkle all with chives or parsley. A quart of very small potatoes scraped or pared and boiled with the meat and beans and arranged round the edge of the beans, will improve the dish. Try †paprika to dust over the whole when ready to be served.

Indian Corn or Maize, as a vegetable food, has few equals and no superiors. It contains fat—which is an uncommon constituent (in any quantity) of vegetables; and in carbohydrate content—which the body can change into fat—it ranks second to potatoes only. Pound for pound, it contains a third more food value than whole milk.

To boil Corn properly, husk the ears, remove the "silk" with a vegetable brush, have the water boiling, and cook the corn rapidly for 5 minutes. Remove from the water at once, and place on a plate which has been covered with a napkin, bringing the ends up so that the corn will be covered.

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† Paprika is red sweet pepper.

Do not add salt, and do not let the ears stand in the water. Serve at once.

"Corn Oysters" is a capital dish.

Take—

2 cups grated fresh corn
2 eggs
3 tablespoons flour
A dash of white pepper.
1 tablespoon melted butter or oil
1 teaspoon salt

Grate the corn from cob, beat the eggs till light, add the butter, salt, pepper and sifted flour, and mix well. If the corn is dry, add a little milk. Brush the griddle as for hot cakes, and put a spoonful of the corn mixture on at a time. Brown slowly on both sides.

For "Scalloped Corn" take—

4 cups grated fresh corn
1 cup fresh breadcrumbs
1 cup milk
1 tablespoon butter
1 teaspoon salt
1/8 teaspoon white pepper.

Score and cut the corn from cob, brush baking dish with a little butter, line with half the breadcrumbs, add half the corn, and dust with salt and pepper. Add the other *half of the crumbs and the rest of the corn, dust with salt* and pepper, pour the milk over all, and dot with the butter. Bake 25 minutes in a hot oven.

Although the cucumber is not a very nutritious vegetable, and is apt to be indigestible in its raw state, when properly cooked it makes a dish suitable to all palates.

For "Stewed Cucumbers" take—

6 large cucumbers (enough to make 2 quarts)
2 tablespoons butter
2 tablespoons flour
2 tablespoons grated onion
1 cup milk
2 teaspoons salt
A dash of pepper.

Wash, pare and cut the cucumbers in inch rounds, put in saucepan, cover with boiling water, boil 20 minutes, pour

into colander and drain 20 mins., then add sauce, which can be made thus—

Put butter and onion into saucepan, cook 5 minutes (but do not let it brown) add flour, mix well until smooth, then add cold milk, boil 5 minutes, add the boiled cucumbers and boil 3 minutes.

The Boulanger or "Egg Plant" in food value is equal only to one-third its weight of whole milk, but cooked in fat it gains much in this respect, and being very palatable is much esteemed as a tasty dish. To fry them, wash and pare the boulanger, cut into ¼ inch slices, dust with salt and pepper, dip into flour, then in egg (one egg beaten with 1 tablespoon milk) and then in breadcrumbs. Fry in deep, hot oil or drippings.

Stuffed and baked, boulangers make a nourishing dish.

Take—

1 boulanger	1 egg
1 cup breadcrumbs	1 teaspoon salt
1 tablespoon dripping	⅛ teaspoon white pepper
1 tablespoon grated onion	A dash of paprika
1 tablespoon chopped parsley.	1 tablespoon melted butter

Wash and pare the eggplant, cut in half the long way, remove centre leaving a "shell" half an inch thick. Put into water at once, or it will become discoloured. Cut the centre into small pieces, put in saucepan, cover with boiling water and boil 10 minutes; then drain and mash. Put the dripping and onion into fryingpan, add the mashed eggplant and breadcrumbs, stirring so that it will fry dry. Add the salt, pepper, parsley, paprika and well-beaten egg, mix well and remove from fire. Remove eggplant from water, dry with a piece of cheesecloth, and fill with the mixture, dust with breadcrumbs, add melted butter, and put in a moderate oven for 30 minutes. Serve with cream sauce.

Kohl-rabi is not a very well known vegetable in British Guiana, but it is worth an extended trial. In flavour it is a

cross between the cabbage and the turnip; in form it resembles the latter more than the former. Its nutritive content is fairly high being nearly half that of milk.

An excellent way of cooking kohl-rabi is to remove the leaves and put into a saucepan, cover with boiling water and boil 40 minutes; peel the turnip-shaped globe and boil about 30 to 35 minutes in another vessel until tender; then add 1 teaspoon salt to each quart of water. Drain the leaves, chop fine and add to each quart of greens 1 cup cream sauce flavoured with 1 tablespoon grated onion. Pour into a shallow dish. Cut the globes into thin slices, then into points, and lay them round the top—or they can be chopped and put through the greens. The leaves get dark when cooked and the globes white, which makes the dish very attractive.

Lettuce, though not of high food value, supplies the very necessary " green " element in a menu, and the coarse outer leaves may be shredded and used for soup, or made into Dutch salad, or shredded and boiled like spinach. To boil lettuce properly, wash the outer leaves and shred ½ inch wide, put into saucepan with a little boiling water, cover for a few minutes or until it heats through, and then boil 20 minutes. Drain and cover with cream sauce. The heart is always best for salads, but sometimes the lettuce does not have a heart and is too coarse for eating raw.

The virtues of the ochro are too well known in this colony for repetition here, but the cooking of the fruit often leaves much to be desired. For " Stewed Ochro " take—

1 qrt ochroes	1 teaspoon salt and a little pepper.
1 tablespoon butter	

Wash and cut off the stem ends, then put in saucepan and add one cup boiling water. Boil slowly 30 minutes without a cover, stirring quite often. Add seasoning and butter. Two cups of fresh corn added make a very nice change, or the dish can be put in casserole and baked 15 to 20 minutes in a hot oven.

Ochroes are also excellent with tomatoes. Take—

1 qrt. ochroes
2 cups tomatoes
1 tablespoon butter
1 teaspoon salt
½ teaspoon pepper.

Wash and cut the ochroes into thin slices. Put the ochroes and the tomatoes on and boil slowly 30 minutes without a cover. Add the salt, pepper and butter. Serve round or over boiled rice

Ochroes are very good in all kinds of soups, and may be combined with nearly any vegetable.

Onions are among the most healthful vegetables which can be eaten. They are also low in price. A pound of onions contains more than two-thirds the food value of an equal quantity of fresh milk. To make stewed onions take—

1 quart onions
1 tablespoon butter
1 tablespoon flour
1 teaspoon salt
½ teaspoon white pepper.

Peel the onions, put on in a saucepan with boiling water enough to cover and 1 teaspoon of salt; boil without a cover for 30 minutes or until tender; drain; put the butter into the saucepan; when melted add the flour, mix well; then slowly add 1 cup of the onion stock; boil until smooth and pour over the onions. A teaspoon of lemon juice if added makes a pleasant change.

To make baked onions take—

1 quart onions
1 cup milk
1 tablespoon flour
1 tablespoon butter
1½ teaspoons salt
A dash of pepper.

Peel the onions; put on with boiling water enough to cover; add 1 teaspoon of salt and boil without a cover until tender; then drain. Brush a baking dish with a little butter; put in the onions and pour over a cream sauce; bake until a light brown. The cream sauce is made as follows:—Put the butter into a saucepan, melt, add flour and mix well; then add the cold milk slowly; stir until smooth and creamy; add the salt and pepper and boil 3 minutes.

The pea has been called the "prince of fresh vegetables." Pigeon peas, Increase peas and Black-eye peas are the most useful in the colony. Next to green corn fresh peas have the highest food value of any garden produce. Pea porridge is an excellent and palatable dish. To make it take—

2 cups shelled peas	1 tablespoon cut parsley
2 cups milk	1 teaspoon salt
1 tablespoon butter	$\frac{1}{8}$ teaspoon white pepper.
2 tablespoons flour	

Put the peas on in 4 cups of boiling water; boil for 30 minutes or until tender (if the water boils away, add more). When the peas are tender then should be added 4 cups of peas and water. Add the boiling milk and the flour and butter rubbed together. Boil three minutes, then add salt; pepper and parsley. Serve with croutons (small cubes of toasted or fried bread.)

Green Peppers, properly cooked and served, make a capital dish and one which, both as a food and as an appetiser, form a valuable adjunct to the dinner table. Cut the peppers in half lengthwise, then in quarters. Remove all seeds and white fibre, soak the peppers in cold water for $\frac{1}{2}$ an hour, drain and put in saucepan. Cover with boiling water, add 1 teaspoon salt, boil 30 minutes, pour into colander and drain. Set the colander on plate and put in a warm oven. Put in a warm dish and pour over 1 tablespoon melted butter and dust with pepper. This is very good with "Hamburg steak" or "Meat Loaf," especially if rice is used with the meat.

The peppers may be stuffed. Take—

6 green peppers	1 hard-boiled egg
1 cup rice	1 raw egg
2 tablespoon finely cut bacon	1 teaspoon salt
1 tablespoon finely cut onion	$\frac{1}{4}$ teaspoon paprika.

Boil the rice as usual. Wash the peppers, cut off stem ends, remove all seeds and white fibre, and soak in cold water for 30 minutes. Remove and dry, then fill with rice prepared as follows:—

Put the bacon in fryingpan, add onion, and fry till light

brown, add 2 cups boiled rice, the hard-boiled egg chopped fine, and heat thorough. Remove from fire and add the well-beaten raw egg, salt and paprika. Mix well. Fill into peppers, dust top with breadcrumbs, place into deep pan, and bake in hot oven 30 minutes or bake in separate ramekins.

Spinach has certain medicinal properties which make it particularly valuable as a foodstuff. It is one of the most desirable of vegetables, and properly prepared is very palatable. Take—

¼ peck spinach	2 teaspoons salt
1 tablespoon butter	⅛ teaspoon white pepper
1 tablespoon flour	1 tablespoon lemon juice.

Wash and clean the spinach, then wash through several waters to remove all sand and grit. Put into boiler with ½ cup boiling water, cover and bring to boiling point quickly. Add 1 teaspoon salt, remove cover and boil 10 minutes, turning quite often. Drain (save the water) and mix with this sauce—

Put the butter into saucepan. When melted, add the flour, mix well, add the water which was drained from the spinach (if there was not a cup-full, add enough cold water to make one) stir till smooth, add 1 teaspoon salt. pepper and lemon juice, and boil 3 minutes.

Squash has much more food value than is commonly supposed. Pound for pound, it has fully two-thirds the food value of milk and it is moreover, so delicate and delicious a vegetable that it deserves more frequent use. The recipes given here avoid the paring of the squash—an important point to the housewife, who dreads squash because of the condition in which it leaves her hands.

Wash and cut the squash into small pieces without paring or removing the seeds. Put in saucepan, cover with boiling water and boil 30 minutes without a cover, or until tender. Pour into a colander and allow to drain 20 minutes, then mash through colander, and to each quart of mashed and strained squash add 1 teaspoonful salt, 1 tablespoon butter and a little pepper.

Squash Fritters are made by adding 3 well-beaten eggs and ½ cup flour to each quart of mashed, strained and seasoned squash. Shape like an "oyster" and fry on a hot griddle, as for hot cakes. This takes the place of meat for supper.

For "Diced Squash" take—

2 qrts. diced squash
2 cups cream sauce
2 tablespoons chopped chives or celery tops.

Wash and pare enough squash to make 2 qrts. Put on fire with enough boiling water to cover, boil 25 to 30 minutes without a cover, pour into colander and allow to drain 10 minutes. Return to saucepan and cover with sauce. Sprinkle with chives or celery.

For the sauce, put 2 rounded tablespoons butter into a shallow saucepan. When melted remove from fire and add 2 tablespoons flour, stir till smooth, return to fire and add 1½ cups cold milk slowly, stirring all the time until thick. Add 1 teaspon salt, ⅛ teaspoon pepper and ½ teaspoon grated nutmeg. Squash needs high seasoning as well as flavouring.

Tomatoes, which when first grown were regarded as poisonous, are now almost as great favourites as potatoes, although they have not so high a food value as their longer known relatives. Take—

6 even-sized tomatoes
2 cups bread-crumbs
½ cup grated cheese
½ teaspoon salt
A little pepper
½ teaspoon grated nutmeg
1 tablespoon butter

Put the breadcrumbs, cheese and seasoning into a bowl, moisten with a little cold milk (enough to hold all together), wash the tomatoes and cut off stem ends, remove centres, and fill in the mixture. Sprinkle with breadcrumbs and place a small piece of butter on each. Bake in hot oven 30 minutes. The centres which have been removed, are boiled

and seasoned to taste, strained and thickened. Pour round the tomatoes when serving.

Another tasty dish is "Fried Tomatoes on Toast." Take—

4 firm tomatoes
½ cup flour
1 cup milk
2 tablespoons dripping
1 tablespoon sugar
½ teaspoon salt
A dash of white pepper.

Wash the tomatoes, cut each one into three slices, removing the skin from top and bottom. Sprinkle with the salt, pepper and sugar, dip into the flour, put the dripping into the fryingpan and when hot add the tomatoes and fry until light brown on both sides. Pour the milk over and boil 3 minutes. Serve on toast.

For "Broiled Tomatoes" wash 6 large, firm tomatoes, cut off blossom and stem ends, dust with salt, pepper and sugar and dip in olive oil, melted butter or dripping. Place on the wire rack in dripping-pan in a hot oven for 30 minutes. Remove and place on rounds of toast. To the drippings or gravy add 1 cup water and 1 tablespoon flour mixed with a little cold water, and boil 3 minutes. If not brown enough, add 1 tablespoon caramel. Pour round the broiled tomatoes. If the tomatoes are very thick, cut in half.

For "Escalloped Tomatoes" brush a dish with dripping, cover the bottom with breadcrumbs, put in 2 cups tomatoes, season with salt and pepper to taste, add 1 tablespoon sugar, cover with breadcrumbs and place in hot oven about 20 minutes or until browned.

Disease in Plants with Special Reference to Fungi Parasitic on Crops in British Guiana.

By C. K. Bancroft, M.A., F.L.S., Government Botanist.

Disease among plants is as inevitable as among animals or man. In olden times plant diseases were regarded as special visitations of divine origin. As early as 350 B.C. Aristotle referred to them in his writings. Since then many other writers have mentioned them. Little interest was however paid to disease in plants until the middle of the last century when the work of De Bary laid the foundation for what is now known as the science of phytopathology. Our knowledge of plant diseases in the tropics has not made the same progress as has that of temperate and sub-tropical countries. The literature is for the most part scattered and therefore difficult to get together. For the accurate identification of species it is not infrequently necessary to refer diseased material to authorities in temperate countries. The examination of material sent over long distances from the tropics has not infrequently led to conclusions being formed which on subsequent examination *in situ* have been found to be erroneous: while the rapid growth of saprophytic organisms on diseased plant material in the tropics frequently tends to mask the real cause of disease. These and other influences render the task of the plant pathologist in the tropics a more difficult one than that of the pathologist in temperate countries.

The need for trained botanists in the tropics is becoming each year more keenly felt, and the fact that there is nowhere in the Empire a recognised school of mycology is much to be regretted. The value of botanical departments whose duty it is to deal with the propagation, distribution and importation of plants, and with the suppression of diseases among crops has only within recent years commenced to earn the recognition it merits.

The importance of quarantine regulations is becoming generally recognised in the tropics, as is evinced by the enactment of plant disease prevention ordinances in most tropical

countries. Plant inspection, too, is being generally adopted. Such measures must eventually lead to a considerable reduction in the quantity of disease among plants.

The first appointment of a botanist whose time was devoted to a study of diseases affecting cultivated crops in the West Indies was not made until the end of the last century, when a mycologist was placed on the staff of the Imperial Department of Agriculture at Barbados. Since then mycologists have been appointed to all of the more important islands and to British Guiana. As the result of this the knowledge of the plant diseases of this part of the world has made rapid progress within a short space of time. Some of the more important problems however still remain to be solved, and the co-operation between the planter and the botanist to be put on a firmer basis.

Nature of Disease.—A plant may be said to be diseased when its normal functions are impaired. Disease may be brought about by the following principal agencies:—

Physical Agencies:—

Soil.
Climate.
Atmospheric impurities

Plants.	Animals.
Fungi.	Insects.
Bacteria	Nematodes.
Slime Fungi.	Higher Animals.
Flowering Plants.	

In addition to these, disease may arise from other causes, known as physiological causes, the exact significance of which is in many cases doubtful. For example, excrescences, warts and tumours frequently arise on plants. The origin of

the mycelium that plants manifest symptoms of disease. In the case of true parasites the mycelium usually enters through the outer layer of cells of the plant and from thence proceeds to grow and to derive its food from the living tissues within. In some cases it taps the outer layer of cells only. The threads of the mycelium may penetrate the living cells or may only grow between them. In the latter case the food is derived by the fungus usually by means of protuberances from the mycelium which penetrate the wall and enter ehe cell. This may result in the death of the cell. The mycelium may only affect a small portion of the plant in which case the extent of the injury is limited. Examples of this are furnished by " leaf-spots" as in the common "Red-Spot of the sugar cane," and in leaf-spotting generally. The mycelium may affect the greater part of the woody tissues of the plant, as in the " die-back " disease or it may affect the greater part of the root system. In the two latter cases the life of the plant is endangered.

Epidemics.—The actual cause of epidemics or sudden outbursts of disease over considerable areas is not known. But it is generally held by the highest authorities that such outbursts are the result of favourable atmospheric conditions coupled with the presence of the host plant in sufficient quantity. The fact that in a mixed cultivation diseases seldom if ever assume the magnitude attained in a pure cultivation bears out this statement. Every student of mycology realises that the words of the late Professor Marshall Ward, one of the most eminent of plant pathologists " he who attempts to grow a plant in pure culture must run the risk of epidemic," are in all cases only too true.

Epidemics of disease among sugar cane, cacao, Para rubber and other crops have occurred even within the short space of time that the author has been connected with West

Indian plant disease—an occurrence which serves to show that they are by no means uncommon. The period of an epidemic is usually limited. It usually gradually increases to a maximum and then rapidly declines. Durng its period of occurrence it may cause such havoc as to render the further continuance of an industry unprofitable. Such was actually the case with the leaf disease of coffee in Ceylon caused by *Hemileia vastatrix*. Generally, industries which have been affected have been able to survive epidemics of disease. This has been due to the remedial measures being sufficiently adequate to cope with the disease and also to other economic considerations. The most serious epidemics which have affected agricultural industries in this part of the tropics are the root disease of sugar cane (*Marasmius Sacchari*), witch-broom of cacao (*Marasmius perniciosus*), the Panama disease of the banana, of which the exact cause is doubtful and the leaf disease of Para rubber (*Melanopsammopsis Ulei.*) The first named was particularly prominent in Barbados in 1901. The witch-broom of cacao seriously affected the cacao industry in Surinam some ten years ago. The Panama disease of bananas has also seriously affected the banana in this part of the world.

Different diseases which now and again assume the proportions of an epidemic are usually caused by fungi which are quite general and are always present in the district. The leaf disease of *Hevea* at present existing in British, in Dutch Guiana, and in Trinidad is an excellent example of this. This disease is caused by a fungus which affects wild *Heveas* in the forest (*Hevea confusa* and *Hevea guianensis*). No other native host is known. The fungus has been observed commonly on these forest trees ; but it has never been found in the forest in epidemic form. The establishment of *Hevea* cultivations (*Hevea brasiliensis*) in British and in ... n followed by the appear ... the

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cultivations in epidemic form. In the former colony the disease has existed in epidemic form for nearly three years and is only now showing any signs of abating. Apart from this the only other diseases which may be said to have occurred in British Guiana in large quantity are the "witch-broom" of cacao and the root disease (called locally "new" or "dry" disease) of the sugar cane.

Spread of Disease.—Fungus disease may be propagated in three ways, either by means of spores or by means of mycelium present in the seed of a plant or in some other part which is used for propagation, such as a bulb or cutting, or else by detached portions of the mycelium which sometimes take a definite form, such as a sclerotium. In so far as the spread of disease by means of spores goes it is necessary to discriminate between the spread from one district or locality of a country to another and from one coutry to another distant country. In the former case wind and animals, more especially insects, are the two primary agents in spore distribution. Spores are usually readily blown by the wind. Insects and other small creatures which creep or fly from one plant to another may distribute spores. Larger animals, *e.g.*, birds, carry spores from one place to another; while man is a recognised agent of spore distribution. How far spores may be blown by wind is not known. But where a disease has been spread from one country to another far distant the spread is usually supposed to have taken place through the transportation of affected parts of plants or parts of plants to which are attached resting or long-lived spores; hence the value of restrictions placed on the importation of plants from abroad.

The following is a list of diseases occurring in British Guiana which have been attributed to definite causes and which have engaged the attention of the author for the past four years :—

Crop.	Common name of Disease.	Causative Organism.
Sugar Cane	Dry or New Disease (Root Disease)	Marasmius Sacchari.
,,	Ring Spot	Leptosphaeria Sacchari.
,,	Rind Fungus	Melanconium Sacchari
,,	Pineapple Disease	Thielaviopsis paradoxa.
,,	Red Rot	Colletotrichum falcatum.
,,	Red Spot	Cercospora Vaginae.
Rice	Blast	Piricularia Oryzae.
,,	Smut	Tilletia horrida.
,,	Stem Rot	Sclerotium Oryzae.
Coconut	Bud Rot	Bacillus sp.
,,	Leaf Spot	Pestalozzia Palmarum.
Cacao	Witch Broom	Marasmius perniciosus.
,,	Black Rot of Pods	Phytophthora Faberi.
,,	Die-back	Thyridaria tarda.
,,	Pink Disease	Nectria Bainii.
,,	Pod Disease	Corticium salmonicolor.
Coffee	Leaf Blight	Sclerotium sp.
,,	Thread Blight	Stilbum nanum.
,,	Root Disease	Hymenochaete noxia.
,,	Leaf and Fruit Disease	Colletotrichum Coffeae.
,,	Viruela	Sphaerostilbe flavida.
Lime	Citrus Knot	Sphaeropsis tumefaciens.
,,	Collar Rot	Fusarium Limonis.
,,	Root Disease	Hymenochaete noxia.
,,	Bird Vine	Loranthus Theobromae.
,,	Sooty Mould	Capnodium citricolum.
,,	Wither Tip, Leaf Spot or Anthracnose	Colletotrichum Gloeosporioides.
Orange	Ripe Rot of fruit	Penicillium olivaceum.
,,	Collar Rot	Fusarium Limonis.
Para Rubber	South American Leaf Disease	Melanopsammopsis Ulei
,,	Root Disease	Fomes semitostus.
,,	do.	Hymenochaete noxia.
,,	Die-back	Thyridaria tarda.

Crop.	Common Name of Disease.	Causative Organism.
Mango	Fruit Disease	Gloeosporium Mangiferae.
,,	Black Blight	Dimerosporium mangiferum.
Breadfruit	Fruit Disease	Gloeosporium Mangiferae.
Banana	Bacterial Disease	Bacillus sp.
,,	Surinam Disease	Ustilaginoidella oedipigera.
,,	Fruit Disease	Gloeosporium Musarum.
Plantain	Bacterial Disease	Bacillus sp.
Indian Corn	Smut	*Ustilago Maydis*.
Cotton	Anthracnose	Colletotrichum Gossypii.
,,	Boll Rot	Bacillus gossypinus.
Sisal	Leaf Disease	Colletotrichum Agaves.
Grape	Powdery Mildew	Uncinula spiralis.
,,	Ripe Rot	*Pencillium glaucum*.
,,	Anthracnose	Guignardia Bidwellii.
Papaw	Leaf Spot	Pucciniopsis Caricae.
Tomato	Wilt	Bacillus Solanacearum.
Pepper	Fruit Disease	Colletotrichum nigrum.
Ground Nut	Leaf Spot	Cercospora personata
Cassava	Leaf Disease	Cercospora Cearae.
Pineapple	Black Heart	Penicillium sp.
,,	Fruit Rot	Thielaviopsis paradoxa.

The above shows that many of the diseases occurring among cultivated crops in the tropics are present in British Guiana. As investigations continue further it is hoped in time to prepare a complete summary of those plant diseases of the colony which are attributable to known causes.

Methods of Treatment.—Throughout the tropical world it is gradually becoming more generally recognised that careful treatment of plant diseases is necessary for the successful cultivation of economic plants. As with the study of human and animal pathology, so with plant pathology, the practice resolves itself into careful observation of the causes and symptoms before any remedial means can be

suggested. For the successful treatment of fungus disease a knowledge of the life history of the fungus causing the disease is of primary importance, in order to know when to attacks the fungus, how to diminish the conditions which are most favourable to its development, and what parts to destroy so as to prevent it from continuing its existence in some future period.

Those methods of treating Fungus Disease which are most commonly practised may be summarised as follows:—

i. The destruction of diseased material, which is best effected by burning the diseased parts or by burying them in pits, with or without the addition of lime, should always be practised; it resolves itself into the diminution of the number of pores by which the fungus reproduces itself. In some cases it is necessary to destroy the whole plant; in others only certain parts of the plant need be destroyed. Diseased material should never be thrown on the manure heap; if this is done a recurrence of the disease is encouraged.

ii. Parts taken from diseased plants should never be used for propagation. Cuttings, bulbs, seeds and tubers produced by diseased plants, if planted, only serve to perpetuate the disease. The disease caused by "*Trichosphaeria Sacchari*, rind fungus of the sugar cane, was widely spread in Barbados and other West Indian Islands by the use of cuttings which were taken from diseased plants.

iii. The application of fungicides may be practised in two ways, either as a preventive measure, i.e., before the disease has appeared, or as a curative measure, i.e., for checking the disease after it has made its appearance. The former is by far the more effective measure; it should always be practised when the disease occurs in the neighbourhood or when it has occurred on the plantation in previous years.

The fungicides which are most commonly in use may be enumerated as follows:—

Sulphur which is applied in the form of "flowers of sulphur" by means of an instrument of similar construction to

a "powder-puff." For mildews, causing spotting of leaves and affecting the delicate portions of the stems of plants sulphur is generally used.

Liver of Sulphur, applied in the form of a solution of 1 lb. in 40 gallons of water by means of a spray. This is used in similar cases to the above.

Bordeaux Mixture. This is most usually prepared as follows :—The 5—5—50 mixture is that generally used in this colony by the Department of Science and Agriculture and gives satisfactory results. The outfit necessary for making 50 gallons of mixture is one oil barrel two half barrels and two buckets. In one half barrel 5 lbs. of copper sulphate are dissolved in 25 gallons of water, by suspending it in a bag that is just submerged under the surface of the water, whilst in the other half barrel 5 lbs. of fresh "quick" or temper lime is slaked carefully by adding just sufficient water to cover it. More water is added little by little until it is worked up into a thick paste. Then the balance of the water to make up 25 gallons is added and the mixture thoroughly stirred. Equal quantities of the copper sulphate solution and the limewater are taken out in the two buckets and poured simultaneously into the 50-gallon barrel. This operation is repeated until the whole of the 50 gallons are mixed together.

There has been a general tendency recently to reduce the proportion of lime in the mixture. A mixture of better quality is said to be made from 14 lb. bluestone, 9 lb. quicklime and 100 gal. of water. A stock solution of bluestone is made by dissolving 2 lb. in each gallon of water and a stock solution of lime from 1 lb. in each gallon of water. The stock solution of bluestone is used at full strength; the lime stock solution is diluted fully with water. To make 100 gallons of the Bordeaux Mixture, take 9 gallons of the

stock of solution of lime, strain and pour into a galvanised iron tank or wooden vat. Add 84 gallons of water. Stir and then pour into the midst of the lime 7 gallons of the bluestone stock solution Stir before use. This mixture has the advantage of possessing only a slight precipitate and of being miscible in a metal receptacle. Bordeaux Mixture is the best fungicide known for general use and is very largely employed for the treatment of fungoid diseases.

Burgundy Mixture is made from 14 lb. bluestone, 17½ lb. washing soda and 100 gallons of water. Stock solutions of 1 lb. bluestone in 1 gallon of water and 2 lb. washing soda in 1 gallon of water. To make the mixture 14 gallons of the bluestone solution is poured into a tub and 77¼ gallons of water are added. In this are poured slowly 8¾ gallons of the washing soda solution, the liquid being stirred all the while. It is employed in a similar manner to Bordeaux Mixture.

Both Bordeaux Mixture and Burgundy Mixture should be tested before use. The former is tested by holding a bright knife in the liquid and observing whether a deposit of copper occurs on the blade. If so, more lime must be added. The latter is tested by means of blue litmus paper. If the mixture is acid the paper will turn red and more washing soda must be added.

The second of this series of articles deal with spraying, the use of other fungicides, soil sterilisation, seed selection and the production of resistant varieties.

(To be continued.)

The Treatment of a Case of Bovine Trypanosomiasis by the use of Sodium Protosanate.

By A. Seton Milne, M.R.C.V.S., F.E.V.M.S.,
Government Veterinary Surgeon.

Bovine trypanosomiasis in British Guiana is not of common occurrence except among imported pure bred stock. Animals imported from the States have from time to time proved susceptible to the disease whch has in every case proved fatal except in the one instance here recorded.

Attempts have in previous years been made to treat the disease with trypan blue, salvarsan and other agents without effect. The successful use of Sodium protosanate in a recent case of trypanosomiasis in a pure bred Shorthorn Bull at the Botanic Gardens is worthy of record. Below is a record taken from my diary of the course of the disease and the treatment in this instance.

"On the morning of the 20th November, 1915, I received a telephone message from the Botanic Gardens to attend on the Shorthorn Bull, as he was suffering from fever.

From the 20th to the 22nd his temperature rose from 102 to 103½. I treated him with ordinary febrifuge. The later course of his illness is shown in the following table:—

Date 1915.	Temperature.		Remarks.
November 22	8 a.m. 12.30 p.m. 4.45 p.m. 9 p.m.	104 105½ 103½ 103½	Off feed.
,, 23	8.30 a.m. 12.15 p.m. 4 p.m.	104 104 3 104 3	Off feed and very dull.
,, 24	6 a.m. 9 a.m. 12 midnight	104.1 104.1 104.1	Off feed and very dull. On this day blood smears were taken for examination by Dr. F. G. Rose, Government Bacteriologist, and myself.
25	6 a.m. 11 a.m. 4 p.m.	103.4 105 105	Off feed and very dull. As the blood smears were proved by Dr. F. G. Rose and myself to contain trypanosomes closely resembling the causative organism of Mal de caderas, I determined to treat the bull with "Sodium Protosanate," a preparation recently received from the Instituto Oswaldo Cruz, Brazil, and intended for the treatment of Mal de caderas.
,, 26	6 a.m. 12 noon 4 p.m.	104.1 104.2 104.2	Up to this date, he had been treated with ordinary *febrifuges*. At 11 a.m. I injected directly into the jugular vein a full dose of the "Sodium Protosanate."
,, 27	6 a.m. 12 noon 4 p.m.	103 103 102	Bright and feeding fairly well.
,, 28	7 a.m. 4 p.m.	102 102	Slight swelling at seat of injection Bright and feeding well.
,, 29	7 a.m 4 p.m.	102 102	Bright and feeding well.
,, 30	7 a.m. 4 p.m.	102 102	Again injected a full dose.
December 1	7 a.m. 4 p.m.	102 102	Bright and feeding well.
,, 2	7 a.m. 4 p.m.	102 102	Sent him out for exercise in the cool of the morning.
,, 3	7 a.m. 4 p.m.	102 102	Again injected a full dose.
,, 4	7 a.m. 7 p.m.	102 102	

From the 4th December the bull's temperature has kept at 102 and at repeated examinations no trypanosomes have been found in his blood. I am sorry to say since treating this bull I have not had another case of trypanosomiasis. I trust

that this Sodium Protosanate will be a success, as large numbers of valuable mules died in 1913-1914 in this colony suffering from Mal de Caderas, whilst we have lost every imported animal which prior to this bull has been affected by trypanosomes."

The *Sun-Drying* of Vegetables.

It is generally admitted that while there is ample scope for the extension of ground provisions in British Guiana that extension is being hampered by the difficulty in treating perishable raw produce locally so as to convert it into a non-perishable and marketable product.

The following article which has recently appeared in the Scientific Reports of the Agricultural Research Institute at Pusa is of great interest in this connexion:—

"One of the difficulties encountered in connection with the supplies needed by the Army of Mesopotamia has been the provision of vegetables for the troops. In the fresh condition, transport is difficult and expensive, and involves the use of cold storage at sea and at the base. In 1916, the Botanical Section of the Pusa Institute was asked by the Quarter Master General to suggest means of overcoming this difficulty. The suggestion was made that the vegetables should be dried in the sun at suitable places on the Western frontier before despatch to Mesopotamia. We undertook to work out the details of the process at Quetta, where the air is exceedingly dry, and to assist the Army in the work in the event of the method being taken up on the large scale. After an interview with Admiral Vaughan, Director of Supplies and Transport, at Delhi in March this was agreed to and a grant to cover the cost of the experiments was placed at our disposal by the Army. While arrangements for the work were under discussion, Baghdad was taken and the Army occupied a fertile region from which supplies of fresh

vegetables could be obtained. The operations on the large scale which had been decided upon at Quetta, were accordingly revised. It was decided to continue the work but on a smaller scale and to dry sufficient produce for the Aden garrison for a year. A portion of the vegetables necessary were grown at Quetta by the Army, the remainder at Dhadar and Mustung by the Kalat State.

"The first step in the process was the working out of a suitable method of drying vegetables in the sun. This was taken in hand early in the season in April and May. The work was practically completed by the middle of June and full details were supplied to the Army before the vegetables at Quetta and Mustung were ready. A large number of vegetables, both European and Indian, were successfully dried, the cooked product in nearly every case being almost indistinguishable from fresh.

"As dried vegetables are very bulky, it was necessary to find some cheap method of storing and transporting the produce. This was accomplished by steaming and pressing into bricks, one pound in weight and of such a size that they could be packed into kerosine tins which could then be soldered. For this purpose, a suitable press had to be designed. The result of this portion of the investigation was a great success and reduced the space taken up by the product to about one-seventh. Packed in this manner, it is possible to compress the weekly supply of vegetables necessary for a battalion on active service into twelve kerosine tins which can be transported by two mules. At the time of writing, the process is in full operation in the Quetta Cantonments where a large drying ground has been arranged by the Army.

"The vegetable drying experiments have aroused a great deal of interest among the *zamindars*, a large number of whom have visited the drying ground. A detailed report of the process is now in the press and it is proposed to have this translated into Urdu for local circulation. There is every prospect that the work will lead to the foundation of a new local industry."

Food Products of the Coconut.

Much attention has for some time been directed to the use of locally grown products to replace a probable shortage in imported foodstuffs owing to the war. The probability of a shortage of fats in the colony in the near future has lead to numerous enquiries having been received regarding the present condition of the coconut industry and the possibility of utilising the coconuts produced locally to substitute some of the fats which are at the present time being obtained from abroad. A brief résumé of the present situation and of the food products of the coconut is therefore not out of place.

The cultivation of the coconut palm in British Guiana is no longer in the experimental stage. A rapid extension of the planting of coconuts has taken place in the colony since 1904. In that year 5,140 acres were returned under this crop while in 1916 there were no less than 20,111 acres. A continued increase in coconut planting is anticipated.

Of this area 12,000 acres have reached the producing stage; while 9,000 acres may be said to be in full bearing. Allowing an average yield of 40 nuts per tree for the latter and 20 for the remaining 3,000 acres the average annual yield of nuts would be 21,000,000 per annum. The annual export of coconuts is nearly 2,000,000. The copra exported annually represents about 300,000 nuts and the coconut oil exported about 200,000 nuts. A very large proportion of the nuts produced is therefore used locally.

The food products of the coconut palm are:—

1. The unripe nuts.
2. The ripe nuts.
3. The juice.
4. The cabbage.
5. The root.

UNRIPE NUTS.

The tender fruit picked from the tree is used by all classes for its cooling, sweetish, clear water and cream-like pulp. The utilisation of the unripe nuts is wasteful, since the coconut posesses far greater value when matured and dried than in the green state.

RIPE NUTS.

The nut of an average fruit when matured comprises 52.5 per cent. of the weight of the whole fruit and the husk 47.5 per cent. The fresh meat comprises 61.5 per cent. of the husked nut, the shell 32.5 per cent. and the water 6 per cent.

Grated Coconut: The fresh kernel when grated forms a suitable addition to rice either when eaten alone or in a curry. It is extensively used in the East in curries and is also employed in this way to some extent by East Indian natives in this colony. Grated coconut is used in the preparation of cakes, puddings, &c. and also in confectionery.

Dessicated coconut: For the preparation of dessicated coconut the nuts are carefully selected, all broken blemished and undersized nuts being rejected. If the nuts cannot be used at once they must be removed to a shed as rain injures the flavour of the product. The shells are removed leaving the kernel entire. The coarse, brown outer surface of the kernel is pared off by means of a suitable knife. The pared kernels are washed well in cold water. The wash water is run into tanks and the oil allowed to rise until it reaches the surface and is then skimmed off. The kernels are quartered and sliced and are given a final washing. The sliced portions are then reduced by machines of different kinds after having been previously graded according to their shape and size. In this way different grades of dessicated coconut are produced.

The wet coconut loses about 50 per cent. of its weight in dessication.

***Coconut milk*: A good recipe for preparing the milk is,**

grate or grind in a mill the meat of the nut as fine as possible and for the meat of each average nut add 1 pint of boiling water. Put in a press and squeeze out the milk separate from the pulp. The milk may be employed for rendering coffee and tea palatable and in place of cow's milk with stewed fruit and for other similar purposes. It contains about 2 per cent. of proteids and 2·3 per cent. of sugars. It has not the same food value as cow's milk and could not be employed as a milk substitute in a dietary for sick persons or convalescents. A quart of coconut milk expressed in this way would be equivalent in protein content to a pint of cow's milk. It would require about three average coconuts to give this.

Coconut butter: To make coconut butter the milk should be allowed to stand in a pan to let the cream rise, which takes about the same time as the cream of cow's milk. The cream should be set to ripen and then churned in the usual way. The butter milk should then be washed out and salt added to taste. A separator may be employed for the milk. The butter is a low grade margarine. The butter is white and needs to be coloured with Anuatto. It takes from 6 to 10 nuts to make a pound of butter. Coconut butter is a low grade margarine. The fat it contains is not so easily digestible as butter. Coconut butter too, lacks the vitamines which are present in butter derived from cow's milk, and which add so greatly to its value as a nutriment.

Coconut oil: The sliced kernel of the coconut dried at ordinary temperatures either in the sun or artificially contains from 30 to 50 per cent. of its weight of oil. One hundred coconuts dry in the husks will yield on the average about 4.5 gallons of oil. To prepare colourless coconut oil the kernel should be boiled in water for a time, then grated and pressed. The emulsion thus obtained should be boiled until the oil is found to rise to the surface. The oil thus made is white and in the tropics is nearly as fluid and limpid as water. According to some tastes it possesses an agreeable odour when fresh; but it is liable to become rancid in a short time.

The oil may also be obtained from the kernel after drying in the sun by expression either in a press or mill. To prepare

this the kernel should be cut into thick pieces and thoroughly dried in the sun for about a week. The oil may then be expressed either in a mill or in an oil-press—such as is used for oil seeds generally. In India the bulk of the commercial oil is made by cold expression from the sun-dried kernel. It may be put to various uses. In this colony it is extensively employed, more particularly by the East Indian population, for cooking, when fresh as a medicine, for anointing the body or as hair-oil, and for burning. The use of coconut oil for cooking is confined almost entirely to the East Indian population. The smell which it imparts to the food is objectionable both to the white and black people. It is, however comparatively easy matter to render coconut oil practically odourless by the care of certain substances.

The oil is used medicinally as a substitute for cod liver oil for improving the general health. According to certain authorities the oil prepared from the fresh pulp administered in a dose of 20 to 30 minims rising to a drachm three times daily, is quite as effective as cod liver oil. In India variously prepared forms of the oil are used medicinally. The oil is also considered to increase the growth of the hair and to make it black.

Native soap is made in India by boiling the oil with earth, salt, saltpetre, quicklime and water.

As a diluent for kerosene oil coconut oil is largely employed. Mixed with kerosene oil, one part to three, it produces a steadier flame than pure kerosene oil.

In addition to these uses the oil is largely employed in the candle and soap trades.

Copra is the kernel of the nut deprived of the greater portion of its water. It is prepared by drying the kernel in the sun or by drying over a low fire. The process of sun drying is a simple and consists in chopping the nut in half and exposing the meat to the sun, care being taken to keep it covered at night. The meat shrinks from the shell after a few days and is then removed and further dried. The drying is usually complete in 6-7 days

When *dried artificially* copra has not the same value as when sundried. Drying over a fire frequently produces a dark coloured copra and rapid artificial drying in a drier is accompanied invariably by loss of oil. Very rapid drying of copra, in about ten hours, is attended by a considerable loss, as much as 15 per cent. more kernel being required to produce a given weight of copra.

Sun-dried copra represents 39.3 per cent. by weight of the husked nut and oven-dried about 38 per cent.

By expression in the cold about 45 per cent. of the oil of the copra is removed, copra meal then remains. The nutritive value of copra meal from expression of freshly dried coconut meat is shown by the following analysis :

Water	7.35	per cent.
Oil	32.14	„
Ash	4.05	„
Crude fibre	37.12	”
Protein (NX 6.25)	20.34	„

Some recipes for the preparation of food products from coconut meat are:—

PRODUCTS.	Coco-nut Meat.	Flour	Baking Powder	Sugar.	Eggs	Milk	Salt	Time Cooked	Manner of Cooking
	Cup	*Cup.*	Tea-*spoons-ful.*	*Cup*	*Cup*	*Cup*	Tea-*spoons-ful*	*Mins.*	
Coconut oven scones ...	½	½	1	¼	½	Sufficient to make batter	¼	30	Hot oven
Coconut gems...	½	⅔	1⅓	1/5	None	...	⅓	30	Do.
Coconut griddle cakes ...	½	½	1	...	1	...	½	Until Brown	Fried in lard or crisco
Coconut a rusks ...	½	½	1	1/5	1	¾	½	30—40	Hot oven
Coconut Bread	¾	¼	5	¼	1	1	¾	30—40	Do.

a one-half teaspoonful each of nutmeg and cinnamon is added to the dough, and the surface is sprinkled with sugar and cinnamon.

It will be noticed that in all these products no lard, crisco, or butter is needed for shortening. Water may be substituted in all cases for sweet milk. In view of these

laboratory tests it seems possible that coconut meal might be substituted to advantage for wheat flour and lard in the preparation of cheap edible products.

THE JUICE.

Is derived by tapping the flowering spike of the palm. When the spathe is one month old it is considered to yield a fair return to the tapper. The spathe is bound tightly to preventing it from expanding; and the point is removed to one inch. The cut end of the spathe is then hammered to crush the flowers within and to direct the flow of sap to the wounded part. The stump is then bound up. This process is repeated morning and evening for a number of days until the spathe is ready to yield toddy. The end of the spathe is fixed into an earthenware vessel to collect the juice. The quantity of juice varies greatly in different trees; but 6 pints to a gallon of juice every 24 hours for two to three weeks is an average yield. In its fresh state the juice is known as "toddy." It is also fermented and distilled to make "arak" or it may be boiled down to sugar and eaten (jaggery.)

THE CABBAGE.

Is the terminal bud of the tree. It makes a splendid vegetable and a good pickle. To obtain the cabbage the tree must however be killed.

THE ROOT.

Is said to be chowed in India like the areca nut with betel leaf.

From the above it will be seen that the coconut can be put to many uses in food. The coconut, however, possesses its highest value in the form of oil. The small exportation of coconuts as compared with the local consumption shows clearly to what extent the use of coconut is recognised in the colony. The amount annually exported in the form of nuts, copra and oil is computed to be able to supply each head of the population with 2.8 lbs. of fat per annum; while if all of the nuts grown locally were utilised for their oil they would supply each head of the population with 26.75 lbs. of fat per annum.

C.K.B.

Botanical Notes.

(i) SOME INTERESTING SPECIES OF PALMS.

Interest has been centred during the past eighteen months in the flowering of species of *Corypha* of which no less than four plants have flowered in the Botanic Gardens since the middle of 1916. The Coryphas are fan-leaved palms of five kinds, native of tropical Asia.

The true Talipot Palm (*Corypha umbraculifera*) is a native of Ceylon and the Malabar Coast. It grows to a height of 50-70 feet: this it takes 25-30 years to attain. When the stem has attained its full size there springs from its apex a flower stalk the largest known among plants; being from 20-30 feet long. From this stalk arises a dozen or more rounded branches, the largest of these being usually about 15 feet. The branches terminate in numerous branchlets and twigs which become richly covered with flowers. When fully grown the flowering mass is often 30 feet long and 20 feet broad. As soon as the flowers open the fan-like leaves below begin to droop and hang down. The flowering period lasts two months. It is succeeded by a period of fruiting, rounded fruits taking the place of the flowers. The whole plant subsequently dies down, blossoming only once in its life. The period of time from the first appearance of the flower stalks to the death of the stem is approximately two years.

The Double Coconut (*Lodoicea Seychellarum*) is a native of the Seychelles. Prior to their discovery in 1743, it was unknown; but its immense woody nuts were frequently found floating on the sea or were thrown upon the shores of the Maldive Islands and gave rise to many fabulous tales. The tree when fully grown has a trunk just exceeding a foot in diameter which bears a crown of large fan-shaped leaves some of which are twenty feet long and twelve feet wide. This palm has two sexes. It is said that in the Seychelles the shortest time taken for a plant to flower is thirty years; while one hundred years are said to elapse before it attains

its full growth. The full height of the stem is said to be in the male tree one hundred feet, the female being shorter. From the time of flowering to the maturation of the fruit in the Seychelles a period of nearly ten years is said to elapse, although the fruit attains its full size in four years.

Three specimens of this palm occur in the Botanic Gardens, Georgetown, in the "Calabash Walk." Of these one is a male and two are females. The history of their introduction into this colony is worthy of note. In his annual report of 1892-3 Mr. G. S. Jenman, F.L.S., late Government Botanist states that twelve nuts of the Coco-de-Mer or double coconut were received from the Seychelles, packed in sawdust in teak cases. Of these eight had germinated on the way and were dead. The other four had not germinated but their vitality must have been lost as they failed to germinate although planted under the most favourable conditions. Later, towards the beginning of 1893, a second consignment of twelve nuts was received packed in damp material; these arrived in good condition. Of them ten germinated, and eight succeeded in passing the stage at which the first leaf expanded above the ground. Mr. Jenman gave the period required for germination as two to six months, the same period being usually required for the spike-like sheath originating in the embryo to appear above the ground Five more plants were added to the collection from a consignment received later in the year. The site selected for their permanent occupation was the calabash avenue running north and south in the nursery. Three plants died in the following year 1894 while one plant is reported to have taken over two years before the point of the spike-like sheath appeared above the surface of the ground. Five more plants died in 1895. In the report of the Acting Superintendent of the Gardens for 1901-2 it is stated that only four plants of this palm remained. One of these was subsequently lost, and the remaining three, two female and one male are still in the collection. One of them produced a pistillate spike in March, 1907, when 14 years old. This flowering as will be seen from the above was quite abnormal in point of time, it having been reported in the Seychelles that the flowers are not produced under thirty years. The same plant produced another spadix in July of the same year. The male plant flowered for the first time in 1908

and the remaining female plant in March 1914. The last-named has up to the time of writing produced three spikes, none of which have been fertile. The first mentioned female plant has borne altogether 26 fruits.

The following are the years of their origin:—

1910	7
1911	2
1912	2
1913	1
1915	6
1916	6
1917	2

The first fruit matured in 1911 and was shown in Trinidad at an Agricultural Conference in 1912. It was the first ripe fruit to be obtained from this palm in the Western Hemisphere. It weighed 21 lbs., rather less than the average weight of the fruit in its native clime. Attention has been paid to the germination of the fruits since 1914

Altogether nine seeds have been sown, seven at the Botanic Gardens and two at the Promenade Gardens, Georgetown. Of these two are dead, four have germinated and the remaining three show no sign of germinating up to the present time. Such records as are available as showing the time required for germination to take place are here given:—

No. of seeds.	Date of sowing.	Date of first appearance of the radicle.	Date of appearance of first leaf above the ground.
2*	28. 8.16	—†	25.8.17
2*	21.11.16	—†	7.10.17
2	5. 1.17	27.9.17	(not yet appeared)

The above records correspond roughly with those obtained by Mr. Jenman from the imported seeds.

*One dead.
†No data available, the seeds having been sown in the ground.

2* 28.8.16 —† 25.8.17

Daemonorops longpipes.—A native of Malaya, possesses the longest stem of any known palm. The plant is bisexual and a climber or rather scrambler. A specimen in the Botanic Gardens, somewhat over twenty five years old now possesses a trailing stem 264 feet long. It has flowered repeatedly. The plant is bisexual, the specimen in the Botanic Gardens being a male.

(ii) PLANTS ON THE KITTY FORESHORE.

In connection with the present investigations in planting of the foreshore in this colony the following interesting and accurate description by Exley Percival, B.A., of the plants one commonly meets on the Kitty Sands is here reproduced from "Timehri" Vol. iii 1889. It will enable our readers who are interested in plant life in nature to recognise without difficulty the species which occur so commonly on this much frequented promenade just outside Georgetown.

"Arrived at the sands whose only drawback is that they are apt to remind one too forcibly of Araby the Blest or the breezes that blow soft o'er Ceylon's isle, from the unfortunate contrast they present; and noting as we step on to them the long "pimpler" spikes of the watchman plant and the dark serrated leaves and small white flowers of the wild senna bush or goatweed. We shall probably notice first the smooth lanceolate leaves and bright yellow blossoms of a shrubby, partially twining bush called the wild physic nut, (*Stigmaphyllum*): each of the five petals, which have a wavy, almost fringed contour, stands somewhat apart from the others on a short stalk or claw, so that the flower cannot be mistaken for any other. Near it we shall find the conspicuous yellow papilionaceous flowers and ternate leaves of the seaside pea trailing and twining in a thick bush. Another much larger papilionaceous plant, trailing but not twining, with big trifoliate leaves, long stout pods, and purple flowers, is the seaside bean (*Canavalia obtusifolia*),†, already mentioned. Its runners are mingled with the long trailing stems of the nanny-foot convolvulus or seaside potato (*Ipomoea Pes-caprae*), whose rather heart-shaped leaves are cloven at the rounded end so as to present some resemblance to the foot of a goat; the flowers are purplish and

† C. *ensiformis* Ed

rather large Two other convolvuluses are found twining on the bushes instead of trailing on the sands: one resembles the common purple convolvulus or wild potato already noticed. This and the last are popularly named from their roots, akin to the sweet potato (*Ipomoea batatas*) itself a convolvulus not unfrequently found running wild; not from affinity with the ordinary potato, which, as we have seen, is a nightshade. The other convolvulus is a large handsome kind called the morning glory (*I. tuba*), whose pure white blossoms two or three inches across, are only to be seen expanded towards dusk or in the early morning The seeds of this and the nanny-foot convolvulus are downy with a brown plush-like pile, and may be strung into necklaces, somewhat resembling, though much inferior to, those made by the Indians from the velvety seeds of the moorie *Quiina guianensis*, sometimes seen in town.

Three or four kinds of the fleshy-leaved, succulent plants characteristic of the seashore will be met with here; the one with pink flowers—the colour being really given by the calyx, for it has no petals—is the seaside purslane (*Sesuvium portulacastrum*). A weak, diffuse plant with small round whitish flower-heads, is a species of seaside everlasting plant or rupture wort (*Alternanthera ficoidea*) : a larger plant straggling among the bushes or rooting by runners with almost cylindrical leaves like little pea-pods, and minute greenish white flowers in short heads in the axils of the upper leaves, is the barilla or Jamaica samphire (*Batis maritima*) ; and a rather similar plant common on the Kelly dam and further up the road with white flowers in scorpioid spikes, grey-green glaucous leaves, and tiny nutlets for its fruit, is the seaside heliotrope (*Heliotropium curassavicum*), also called wild lavender.

Among the higher flowering bushes here the commonest is the well-known courida bush (*Avicennia nitida*), with lanceolate leaves and small bunches of white or cream-coloured flowers, dotted with the dark projecting stamens, and generally mixed with already faded blossoms. There is no better plant than this for binding and preserving an exposed sea-shore, its roots everywhere penetrating the soil and sending up short upright processes from which engineers

might well have taken the plan of driving in stakes to break the waves upon a sea-front in shallow water. Here too we shall find the wild mahoe (*Paritium tiliaceum*) growing twelve or fifteen feet high with broad rounded leaves curiously snipped into a short abrupt point at the end of the mid-rib and large yellow flowers like an hibiscus; and the seaside mahoe or poplar tree (*Thespesia populnea*) with very similar yellow flowers shaded with purple, and handsome glossy leaves heart-shaped at the base and pointed, and conspicuously marked with the light green mid-rib and veins relieved upon a darker ground. Both are good fibre plants, their inner bark furnishing a kind of bast commonly used by gardeners."

Plant Diseases and Pests Notes.

(I.) EXTERMINATION OF COUSHI ANTS.

Owing to numerous enquiries having been recently received regarding the destruction of coushi ants the following account of the best mode of destroying the nests is here given:—

All exit holes should be carefully stopped up with mud or earth well rammed down. In the smallest nests one large central hole is left open; in the largest nests as many as four holes may be left exposed. It is absolutely essential that all the other holes be carefully and securely sealed up. Into each of these open holes about three tablespoonfuls of carbon bisulphide should be poured so that the fumes penetrate well into the heart of the nest. After some minutes a torch on the end of a long stick should be applied to these openings, when a violent explosion will take place. This light should be put to every hole where the bisulphide has been placed. As soon as the explosion has taken place all

holes must be covered up and the nest left for several days. If after some weeks ants are observed to still issue from the nest another application must be given.

Carbon bisulphide may be obtained from Messrs. Brodie and Rainer, Georgetown. Care must be exercised in its use as it is extraordinarily inflammable.

(ii.) *Spraying of Cacao Trees.*

A paper published in the Bulletin of the Department of Agriculture of Trinidad and Tobago Vol. xvi., Pt. 3, 1917, describes an experiment on the spraying of cacao trees by Mr. J. B. Rorer, *Mycologist to the Board of Agriculture of* Trinidad. The experiment was undertaken for the purpose of testing the efficacy of Bordeaux Mixture with an infusion of tobacco added, as a control for the black rot disease of cacao pods and the insect thrips.

In a field at Sangre Grande containing, 1.200 trees three plots of 400 trees each were selected. One plot was sprayed and the remaining two left unsprayed. The trees were sprayed three times on August 23, September 14 and October 19. The formula employed for the mixture was 5 lb. copper sulphate, 5lb. quirklime to every 50 (American) gallons of water: to this 5½ oz. of coarse tobacco was added. The first picking of the fruit was made on November 22 and picking continued at intervals until June 11 of the following year. The results of the pickings were:—

400 trees sprayed yielded 10,921 pods of which 9,933 were sound.

800 trees unsprayed yielded 6,550 pods of which 5,168 were sound.

The cost of spraying worked out at a little over 7 cents per tree.

The results of this experiment should prove of great value to local cacao growers.

(iii) *The Mango and Breadfruit Disease.* This disease which has already been referred to in the Journal, Vol. VI. No. 1. p. 14, has been much in evidence during the past six months and the number of fruits which have been rendered uneatable through its agency must have been enormous.

The following is a description of the disease on the breadfruit:—

The disease commences as small brownish spots generally approximately circular in shape which are to be observed on the surfaces of the breadfruits. On close examination it can be noticed that the centre is generally darker than the edges of these discoloured areas, and it is probable that these darker sunken areas mark where infection took place. These discoloured areas become sunken and gradually assume a darker brown hue. They usually measure about 1½ to 2 inches in diameter, but cases have been observed where they measure up to 4 inches in diameter. If one of them is cut through it will be seen that the internal tissues are also discoloured and present a brownish hue; and they eventually become "water-soaked" and slimy.

The disease may affect the breadfruit at any stage of its growth, when the fruits are young or when they are practically ripe. Where only a single spot becomes affected the fruit may ripen and a portion of it can be used, but when the fruit is affected at several points is usually falls before it is ripe, and rots.

The disease has been abundant on the East Coast of Demerara, and the West Bank, Demerara River, It is probable that the unusually wet conditions and high humidity prevailing during the latter months of the past year have favoured the spread of the disease.

Bordeaux Mixture is an effective remedy and should be used wherever the disease occurs. Excellent results have been obtained by two sprayings with this mixture, one when the fruit is just set and the other three or four weeks later.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the year 1917. The corresponding figures for the two previous years, and the averages for the four years previous to that, are added for convenience of comparison.

Product.	*Average 1911-14.*	*1915.*	*1916.*	*1917.*
Sugar, tons ...	92,706	116,223	101,649	114,007
Rum, gallons ...	2,932,547	4,698,230	4,386,854	3,415,921
Molasses, gallons...	1,221	...	...	149,940
Cattle-food, tons ...	4,989	2,233	997	2,425
Cacao, cwts. ...	463	533	416	70
Citrate of Lime, cwts.	16	170	466	155
Lime Juice, ordinary gals.	*	4,440 ‡	8,565 †	13,596
Lime Juice, conc., gals.	*	*	*	3,691
Essential Oil of Limes, gals.	*	*	290	251
Coconuts, thousands	1,211	2,090	1,631	1,911
Coconut Oil, gals....	*	22,059	17,948	26,674
Copra, cwts. ...	1,346	1,619	2,117	1,507
Coffee, cwts. ...	1,288	1,538	4,475	2,347
Kola-nuts, cwts. ...	1	18	26	34
Rice, tons ...	5,022	9,058	13,008	14,367
Ricemeal, tous ...	1,349	266	300	140
Cattle, head ...	925	619	632	872
Hides, No. ...	4,650	4,584	4,587	1,519
Pigs, No. ...	1,408	1,193	1,160	455
Sheep, head ...	86	12	69	18
Balata, cwts. ...	9,384	13,903	12,952	14,249
Charcoal, bags ...	67,570	58,424	53,527	44,986
Firewood, Wallaba, etc., tons ...	9,375	8,905	10,364	7,308
Gums, lbs. ...	3,183	...	1,118	112
Lumber, feet ...	330,872	225,453	360,439	191,091
Railway sleepers, No.	8,976	2,556	5,525	30,633
Rubber, cwts ...	14	41	139	132
Shingles, thousands	2,403	2,214	2,355	3,208
Timber, cub. ft. ...	292,015	113,861	138,342	51,769

† No distinction recorded between "ordinary" and 'concentrated" juice.

‡ Recorded as "fruit juice."

* No records available.

Attendances at the District Gardens.

The *following* are the attendances at District Gardens, which are controlled by the Board of Agriculture, for 1917 *and for the* previous five years. These Gardens which were suspended by the action of a resolution of the Combined *Court* in March 1915 were reconstituted in 1916. Some time must necessarily elapse before the number of attendances reach, the figures recorded in previous years; but it is pleasing to announce that the numbers for 1917 do not fall *far* short of those recorded in the years 1912-14.

YEAR.	Bourda.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	Suddie, Essequebo.	Dem Amstel.	Houston, E. Bank.	Wakenaam.	Total Attendances.
1912 ...	5,514	4,395	3,302	2,100	2,544	2,156	1,718	21,729
1913 ...	5,156	4,535	2,519	3,399	2,568	1,836	1,319	21,332
1914 ...	4,243	3,869	2,443	3,025	1,791	1,653	1,533	18,577
1915 ...	1,123	1,006	769	59	503	339	401	4,200
1916 ...	4,705	1,161	1,510	225	623	2,251	1,297	12,026
1917 ...	4,991	2,820	1,366	3,297	1,186	2,564	1,663	17,887

Meteorological Data, 1917.

Months.	RAIN-FALL.	NUMBER OF DAYS OF RAIN						EVAPORATION
	Inches.	Under ·10 Inches	·10 to ·50 Inches	·50 to 1.00 Inches	1.00 to 2.00 Inches	Above 2·00 Inches	TOTAL DAYS	Inches
January ...	10.53	9	8	2	2	1	22	4.13
February...	2.86	4	9	1	...	...	14	5.35
March ...	2.84	13	4	...	1	...	18	5.94
April ...	1.87	10	2	1	...	...	13	6.99
May ...	7.97	5	5	1	...	1	12	4.77
June ...	12.48	3	7	2	5	1	18	4.21
July ...	9.56	5	8	8	2	...	23	3.43
August ...	6.47	6	9	2	2	...	19	4.25
September	4.52	4	6	2	1	...	13	5.46
October ...	5.46	4	5	3	1	...	13	5.37
November	11.73	6	9	2	1	2	20	4.52
December	12.81	5	5	7	1	2	20	3.37
Totals ...	89.10	74	77	31	16	7	205	57.79

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Months.
January ...
February ...
March ...
April ...
May ...
June ...
July ...
August ...
September ...
October ...
November ...
December ...
Means ...

A moderately wet January was followed by a dry February and March. The rains which usually commence towards the end of April did not appear until the 20th of May. June was a wet month whilst August, September, October and November cotained more wet days than in an average year. The evaporation percentage of the rainfall was 64·8.

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AIR TEMPERATURE AND HUMIDITY.

Months.	Air Temperature			Humidity.
	Maximum.	Minimum.	Mean.	Mean.
January ...	81.7	74.1	77.9	78.7
February ...	82.4	74.0	78.2	75.3
March ...	82.7	75.0	78.8	75.0
April ...	84.8	75.9	80.3	73.4
May ...	85.1	74.5	79.8	77.9
June ...	84.3	73.5	78.9	81.6
July ...	84.6	73.7	79.1	84.0
August ...	85.5	74.1	79.8	81.5
September ...	85.6	75.2	80.4	80.7
October ...	85.5	75.5	80.5	79.9
November ...	85.0	74.8	79.9	80.4
December ...	84.7	73.8	79.2	81.7
Means ...	84.3	74.5	79.4	79.2

The mean shade temperature was equal to the average of previous years.

The humidity was greatest in July and least in April.